SUPERFUND STANDBY PROGRAM
New York State
Department of Environmental Conservation
625 Broadway
Albany, New York 12233-7016

SITE IDs 279-282, 339: CHURCH & DWIGHT COMPANY, INC.

SITE SUMMARY REPORT

Onondaga Lake Project
Task 5: 104(e) Review

Site No. 734030-002
Work Assignment Number D003060-27

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FIGURES

1.0 SITE DESCRIPTION

Nine mailings with a claim of confidentiality were received from Church & Dwight (Company ID 2035), including:

- Mailing No. 1: October 15, 1996
- Mailing No. 2: November 27, 1996
- Mailing No. 3: July 1, 1997
- Mailing No. 4: January 6, 1998
- Mailing No. 5: July 2, 1998
- Mailing No. 6: December 23, 1998
- Mailing No. 7: June 29, 1999
- Mailing No. 8: December 22, 1999
- Mailing No. 9: October 16, 2000.

The information referenced in this report was mainly obtained from the 104(e) responses of Church & Dwight. Information obtained from other sources is noted, as necessary.

1.1 Location

Church & Dwight historically operated at five facilities near Onondaga Lake. Four of the five Church & Dwight facilities are located within an area that is approximately 80 acres in size in Syracuse, Onondaga County, New York. The fifth Church & Dwight facility was located in Solvay, New York in Onondaga County. Figure 1 shows the location of these facilities in relation to Onondaga Lake. The first site, operated by Church & Dwight from 1896 to 2002, was known as the Willis Avenue Plant and was located at 1416 Willis Avenue (Site ID 279). In 1984, Church & Dwight purchased three facilities from Allied Corporation (currently known as Honeywell) including the Ammonium Bicarbonate (ABC) facility located at 1421 Willis Avenue (Site ID 280), and the Refined Bicarbonate (RBC) facility (Site ID 281) and the Snowflake (SFX) facility (Site ID 282), both located at 1413 Willis Avenue. The ABC, RBC, and SFX facilities are located on the southwest side of Willis

Avenue, and the Willis Avenue Plant was located on the northeast side. These four facilities are bound by Milton Avenue to the south and Conrail railroad tracks to the north, east, and west. In 1989, Armand Products Company, which is a co-venture between Church & Dwight and Occidental Petroleum Corporation, purchased the AlliedSignal Potassium Carbonate (PotCarb) facility (Site ID 339) at 1700 Milton Avenue in Solvay, New York. The site was not operated by Church & Dwight and was transferred back to AlliedSignal in 1994. The site locations are also shown on the USGS topographic map in Figure 2.

1.2 Geology

The surficial geology of the Syracuse area was strongly influenced by the most recent glacial advance (Wisconsin age, 12,000 to 14,500 years ago). The area occupies a region that was covered by Lake Iroquois, a large glacial lake situated in front of the ice margin. The broad flat-lying plains situated north from Syracuse to Lake Ontario were formed beneath Lake Iroquois and are characterized by lacustrine fine sand and silt deposits. Additional glacial features common to the region are moraines, drumlins, U-shaped valleys, and meltwater channels.

Onondaga Lake and all its major tributaries lie within glacial meltwater channels. These features originally were conduits carrying meltwater at large volumes and high velocities away from the glacier. Sediment types characteristically found in meltwater channels are sands and gravels. These relict features form important water bearing and transmitting units which form an irregularly branching, net-like pattern.

The bedrock geology of the greater Syracuse area includes Lower to Middle Paleozoic age sedimentary rocks predominated by carbonate (dolostone and limestone) and shale, and containing some sandstone, siltstone, and evaporites. Bedrock directly beneath the area (as well as underneath Onondaga Lake) is Silurian Vernon Shale (Rickard and Fischer, 1970) which has low permeability, but does possess secondary porosity due to fractures. The Church & Dwight facilities are located within the physiographic boundary of the Ontario-Mohawk Lowland and are generally flat without any dominant trend to landforms. The soils

in the surrounding areas are classified as "Urban Land" and the overburden is glacial till. Underlying the glacial till is the Middle Shale unit consisting of the 350-foot thick Camillus Shale formation, underlain by the 500-foot thick Vernon Shale formation. The Camillus Shale consists of grey thin-bedded shale, gypsum beds, salt, and dolomite. The Vernon Shale consists of red soft shale, beds of green shale, gypsum, and dolomite.

Soil borings were performed by Church & Dwight when considering the purchase of the Allied properties west of the Willis Avenue Plant. Investigations were performed in 1987 and 1992, and the overburden conditions in the site area are consistent with the general soil profile for the area, i.e., glacial till overlying shale (Mailing No. 1, p. 002603).

In the "Ground Water Assessment" report prepared for Church & Dwight in 1988, O'Brien & Gere indicated that there is between 5 and 15 feet of fill material in the vicinity of the ABC facility that consists of "layers of gravel, sand and cinders and a grayish white powdery ammonia bicarbonate sludge" (Mailing No. 1, p. 002603). It was also indicated that there is "up to 21 feet of fill composed of a mixture of sand, gravel, cinders, and miscellaneous construction debris (concrete, bricks, etc)" downgradient of the Willis Avenue Plant (Mailing No. 1, p. 002604).

1.3 Hydrogeology

According to the Syracuse West USGS topographic map, the ground surface elevations at the four Church & Dwight sites, not including the Potcarb facility, range from approximately 395 to 425 feet NGVD (see Figure 2). Shallow groundwater is expected to flow in a northeasterly direction toward the East Flume and Onondaga Lake based on ground surface contours. Groundwater elevation data, obtained by Church & Dwight in 1992, range from elevation 402 feet in the vicinity of the Willis Avenue Plant to elevation 392 feet west of Willis Avenue (Mailing No. 1, pp. 002463, 002466).

1.4 Surface Water Hydrology

The Church & Dwight Willis Avenue sites are located approximately 1,000 feet to the southwest of the East Flume, 2,500 feet to the southwest of Harbor Brook, and 2,000 feet southwest of Onondaga Lake. A Spill Prevention Report indicates that, given the slope of on-site drainage ways, the nature of the surrounding land use, and the distance from Onondaga Lake, it is possible for a spill at the Church & Dwight sites to directly impact the lake (Mailing No. 1, p. 005497).

2.0 SITE HISTORY

2.1 Owners/Operators

Church & Dwight leased the Willis Avenue Plant property from Allied Chemical's predecessor in interest, the Solvay Process Company, in 1896, and subsequently purchased this original tract of land by deeds obtained in 1972, 1976, and 1985 (Mailing No. 1, p. 000065). Operations at the Willis Avenue facility were discontinued and the facility was in the process of being demolished in 2003. The ABC, RBC, and SFX facilities were originally constructed and operated by Allied Chemical and were purchased by Church & Dwight on December 28, 1984. Church & Dwight operated the ABC facility from January 1985 through April 27, 1996, when facility operations were discontinued. Church & Dwight operated the RBC facility from January 1985 through July 1985, when operations were discontinued prior to demolition of the facility in 1987. Church & Dwight operated the SFX facility from January 1985 through July 1985 (Mailing No. 1, p. 000069). Also on December 28, 1984, a utility tunnel that connects the Willis Avenue Plant and the RBC facilities was purchased from Allied. The tunnel was closed and filled by Church & Dwight in May 1993.

In 1989, Armand Products Company, a co-venture between Church & Dwight and Occidental, purchased the Allied Potassium Carbonate facility (SIC code 2819) in Solvay, New York. It had been closed since 1976. No operations were conducted by Church & Dwight at the plant, and the facility was transferred back to AlliedSignal in 1994 (Mailing No. 1, p. 000069). Therefore, this site will not be discussed in the following sections.

2.2 Site Operations

The Willis Avenue Plant (SIC code 2841) formerly consisted of thirteen buildings, as shown on Figure 3. The site was used for the packaging and shipping of sodium bicarbonate (baking soda) and Borax (sodium borate), assembly of equipment used in the application of Armex®, a "baking soda-based abrasive blast media" (Mailing No. 1, p. 000071) which is

manufactured off-site, manufacturing and packaging of sodium carbonate monohydrate ('monohydrate'), sodium carbonate decahydrate ('decahydrate'), powdered and liquid laundry detergents, carpet, room and cat litter deodorizers, laboratory testing, product development, and pilot plant operations. The specific operations within each building were as follows (Mailing No. 1, pp. 000066-000068):

- Buildings 1 and 2: Packaged sodium bicarbonate between 1896 and 1988. Until 1938, baking soda was received by rail cars, at which time the utility tunnel beneath Willis Avenue was constructed and used to transport the product from the Allied RBC facility. Formerly, Building 1 received packaging supplies for liquid detergent.

- Building 3 was part of the original 1897 packaging plant used as office space. A 500-gallon tank for sulfuric acid was installed in November 1997 that was used for pilot testing of a new brightener for liquid detergent, and was removed from service in March 1998.

- Building 4 was part of the original 1897 packaging plant and contained two 10,000-gallon holding tanks for No. 2 fuel oil that were removed in 1969.

- Building 5 was also part of the original 1897 packaging plant and housed electrical transformers since 1917 and was also used for storage. In 1969, dry-type transformers were replaced by a new transformer. Lubricating oil had also been stored in Building 5. Utilities for the liquid laundry detergent operation recently occupied these buildings before operations were discontinued.

- Building 6 never existed.

- Building 7, built in 1896-97, housed two boilers until 1946. The building housed only an air compressor until 1979, when two new boilers were installed and operated until 1992. They were removed in 1995, and the building housed the liquid laundry

detergent operation until operations ceased in 2002. The building formerly contained ten process and storage tanks, and associated piping.

- Building 8 housed the monohydrate bagging operation, the monohydrate "solution" room and storage, and the assembly area for Armex® application equipment.

- Building 9 was used for packing washing soda since the late 1940s, and powdered detergent since 1972.

- Building 10 was built in 1947. Until 1972, it was used for storing loose washing soda. Since 1972, the building was used for the manufacture of powdered detergent. A small pilot plant for R&D testing of powdered detergents was constructed in 1990. A portion of the building, built in 1972, was referred to as the non-ionic building and housed liquid raw material holding tanks and process tanks.

- Building 11 never existed.

- Building 12 was added to the original building in 1919 for the warehousing of baking soda. Executive offices and a baking soda storage area were added in 1939. The building also housed a product quality control area. Packaging operations were conducted on the first floor from 1939 to 1969, and on the second floor from 1969 until operations ceased. In 1995, blow-molding equipment for the forming of liquid detergent bottles was added. Liquid detergent was also bottled in the building.

- Building 13 never existed.

- Building 14 was used for warehousing and storage of packing supplies. A product quality control laboratory was housed in the building prior to 1976.

- Building 15 was a covered loading area.

The ABC facility (SIC code 2819) was purchased by Church & Dwight in December 1984. Church & Dwight operations included manufacturing and packaging of ammonium bicarbonate, a food leavening agent, between January 1985 and April 1996, when the facility was closed (Mailing No. 1, p. 001448).

The RBC facility (SIC code 2812) was purchased by Church & Dwight in December 1984. Church & Dwight operations included manufacturing sodium bicarbonate from January 1985 through July 1985. The facility was demolished in 1987. Church & Dwight also purchased a tunnel underneath Willis Avenue on December 28, 1984 that was used to transport baking soda between the Willis Avenue Plant and RBC facilities (Mailing No. 1, p. 000038). The tunnel, which also contained water and steam utility pipes, was closed and filled in 1993.

The SFX facility, which is also known as the Snowflake Building, adjoins the ABC facility. Church & Dwight produced sodium sesquicarbonate at the SFX facility from January 1985 through July 1985.

The processes conducted at these four facilities, as described by Church & Dwight, are listed below. Details regarding the types of waste that have been generated are provided in Section 2.3.

- Packaging of sodium bicarbonate (baking soda) (1896-1988): Bulk sodium bicarbonate was transferred from Allied by railcar prior to 1939, and thereafter by conveyor, to a 200-ton storage bin in Building 12. The product was also weighed and packaged into individual cartons on the third floor of Building 12. The finished product was stored on the first and fourth floors, and shipped from the second floor by rail and truck. Church & Dwight stated that "prior to 1970, waste cartons and product in floor sweepings, were colleted, placed in disposal bins, and may have been taken to Allied to be disposed at the Allied landfill [the name and location were not provided in the mailings] according to anecdotal accounts of long-time employees. During the 1960s, Church & Dwight owned a truck and transported some of these industrial wastes directly to the Allied landfill. After 1970, Church

& Dwight removed such wastes to a 22 cubic yard open-topped steel container at the back of the plant, and contracted for waste haulers (Rubbish Removal, Inc.) to remove the wastes periodically. The process wastestreams did not vary greatly in composition over the history of the plant, although quantities may have risen after 1917 with production increases, despite new packaging machines and other work changes to minimize production losses. Beginning in 1976, some of the recaptured sodium bicarbonate was recycled in the laundry detergent process or packaged and sold as technical grade sodium bicarbonate" (Mailing No. 1, pp. 000070, 000073).

- Sodium carbonate monohydrate (1927-2002): Bulk sodium carbonate (soda ash) was pneumatically unloaded from railcars into two 20-ton storage silos, then transferred to dissolving tanks in the solution room. The soda ash was mixed with water and/or diluted sodium carbonate liquor. The solution was filtered, then recrystallized in an evaporator. Filter aid (diatomaceous earth) and carbon were added to facilitate filtering in a pressure leaf filter and polish filter. The liquor was pumped to a storage tank, then piped to a thickener tank. A circuit consisting of the thickener tank and an evaporator (with an internal steam basket/heat exchanger) was used to circulate the liquor and the crystals generated from the super-saturated solution. The crystals settled in the thickener tank and were drawn off to a centrifuge, where the liquor and rinse water was removed to a holding tank. The crystals were conveyed to a rotary dryer, and the finished product was screened, milled and packaged in bags or drums. Dust was captured through a cyclone/dust-collector/baghouse operation and reused in the process, along with the dilute liquors and rinse water from the holding tank (Mailing No. 1, pp. 000070, 000074).

- Sodium carbonate decahydrate (washing soda) (1917-1995): Bulk soda ash was unloaded and placed in storage silos, as described in the monohydrate process, then conveyed to a mixing screw conveyor. Waste liquors from the sodium carbonate monohydrate process were sprayed onto the ash and the material was air-dried and cooled, then packaged in cartons and bags. Washdown from equipment is reused in

the process. Floor sweepings were disposed of as industrial waste (Mailing No. 1, pp. 000070, 000074).

- Packaging of Borax (1960s-1977): Bulk Borax (sodium borate) was unloaded from railcars into a storage bin, then packaged into cartons. Any product in floor sweepings was recycled (Mailing No. 1, pp. 000070, 000075).

- Powdered laundry detergent (1972-2002): Raw materials were received from bulk railcars (soda ash and ethoxylated alcohol), tanker trucks (sulfuric and polyacrylic acids), and in bags ("minor" ingredients such as cellulose and tri-sodium phosphate), drums (perfume), and super-sacs (brightener). A mixture of sulfuric acid and ethoxylated alcohol produces a surfactant, which was sprayed onto the dry powders in mixers. Prior to 1980, the surfactant was purchased as a raw material, linear alkyl sulfonic acid. Bulk soda ash was unloaded from railcars to a 50-ton storage bin in Building 10. Ingredients were metered for weight, then mixed in one of four blenders. The product was then conveyed to the filling equipment and packaged in cartons. Dust was exhausted to the outside, where cyclones and dust collectors capture material which was returned to the process. Equipment washdown was channeled into floor drains and piped to the pretreatment system, then discharged into the municipal sewer system. Floor sweepings were disposed of as industrial waste (Mailing No. 1, pp. 000070, 000075).

- Carpet and room deodorizers (1980-1996): Bulk sodium bicarbonate was unloaded from railcars or super-sacs, conveyed to a blending operation, mixed with a pre-blended perfume carrier and then packaged into cartons. Dust collectors returned dust to the process. Floor sweepings were disposed of as industrial waste (Mailing No. 1, pp. 000071, 000075, 000090).

- Liquid laundry detergent (July 1995-2002): Raw materials were received by bulk railcar (ethoxylated alcohol), bulk trucks (surfactants, sodium hydroxide, sodium silicate), drums (perfumes, EDTA, dye), and bags (brightener). The liquid

ingredients were metered into a mixing tank with softened water and blended. Plastic resins, received in bulk railcars, trucks, or gaylords, were blended together and blow-molded into plastic bottles. The finished product was then pumped into the filling operation and into the bottles. Equipment washdown was treated in the facility's pretreatment system before being discharged into the municipal sewer system. Defective bottles were reground and reused in the blow-molding process, or removed from the facility and recycled (Mailing No. 1, pp. 000071, 000075).

- Armex® equipment assembly operations (1995-2002): The operation included the assembly of abrasive media blasting equipment. About one cup of baking soda was used to test each assembly and was collected in floor sweepings, which were disposed of as industrial waste (Mailing No. 1, pp. 000071, 000075).

- Lab (1972-1975): An on-site laboratory performed product quality control. Small quantities of toluene, acetone, chloroform and other solvents were used for testing. The chemicals are accumulated into 35-gallon drums, labeled and manifested for off-site disposal (Mailing No. 1, pp. 000071, 000075).

- Maintenance shop (dates not provided in the mailings): Solvents and degreasers used in the shop, located in Building 12, were supplied and removed by Safety-Kleen. Used paint and paint cans were collected and stored in Building 5, and were occasionally manifested with other hazardous wastes (Mailing No. 1, p. 000076).

- Manufacturing and packaging of ammonium bicarbonate (January 1985 - April 1996): Raw materials (anhydrous ammonia and carbon dioxide) were received at the ABC facility by bulk railcars or trucks. The ammonia was vaporized into water, creating ammonium hydroxide, and then pumped to precipitating columns where carbon dioxide was sparged into the bottom of the units. As the solution was cooled, crystals of ammonium bicarbonate formed and precipitated. The crystals were drawn off, centrifuged, dried by a heated air fluid-bed dryer and cooled in a rotary cooler, then screened and placed in storage beds. Some of the product was mixed with

magnesium carbonate, to form "treated" ammonium bicarbonate. The product was then packed in bags and drums. Equipment washdown was pretreated before discharge to the sewer. Floor sweepings were disposed of as industrial waste. Vapors and fine dusts were scrubbed, and the stripped gasses reused in the process. Dust from the dryers, coolers and conveyors was recaptured and mixed with the finished product (Mailing No. 1, pp. 000071, 000076, 000077).

- Manufacture of sodium bicarbonate (January 1985 - July 1985): Concentrated sodium carbonate liquor was piped from Allied's soda ash facility to an external tank at the RBC facility. It was then pumped to carbonating columns where carbon dioxide gas from the Allied facility was sparged into the bottom of the columns, producing sodium bicarbonate solution. As the solution was cooled, crystals of sodium bicarbonate that precipitated were drawn off, centrifuged, dried by a heated air dryer and stored in bulk storage bins. The finished product was screened, bagged and shipped by rail or truck, or sent by conveyor through the utility tunnel to the Willis Avenue Plant. Waste liquors were piped off to the SFX facility for use in the sodium sesquicarbonate process (Mailing No. 1, pp. 000071, 000077).

- Manufacture of sodium sesquicarbonate (January 1985 - July 1985): Concentrated sodium carbonate liquor from the Allied soda ash facility and waste liquor from the sodium bicarbonate process were piped to the Snowflake facility, fed into precipitators, and evaporated, forming crystals of sodium sesquicarbonate which were drawn off, centrifuged and dried. The finished product was bagged or placed in bulk railcars or trucks. Equipment washdown was collected and reused in the process (Mailing No. 1, pp. 000071, 000077).

2.3 Generation and Disposal of Wastes

Church & Dwight has been designated as a Small Quantity Generator of hazardous wastes, produces wastewaters that are "either pretreated and discharged to the municipal sewer

system or are recycled" (Mailing No. 1, p. 000078), produces industrial wastes that have been disposed of at industrial landfills, and maintains permits for continuous air emissions.

Industrial waste from the Willis Avenue Plant and the former Allied properties has typically consisted of paper, cardboard and floor sweepings. The sweepings include wood scraps, sodium bicarbonate, sodium sesquicarbonate, decahydrate, used air filters, sodium borate, powdered laundry detergent, soil and sodium carbonate. The composition of the waste stream is not believed to have varied significantly over time, although the quantity of waste is likely to have increased with significant increases in production, beginning around 1917 (Mailing No. 1, p. 000073). Church & Dwight did not provide a destination for all of these wastes prior to 1970, indicating in their submittal that "very little information is available until the mid-1960's" (Mailing No. 1, p. 000078). Church & Dwight believes that a portion of these wastes were disposed of in Allied's landfill (name and location not provided in the mailings), and were transported there by both Allied and Church & Dwight personnel.

Beginning in 1970, Church & Dwight contracted with Rubbish Removal, Inc. to transport the solid industrial wastes from the site. Church & Dwight estimated that the volume of wastes transported from the Willis Avenue Plant by Rubbish Removal decreased from as much as 528 cubic yards (cy)/year in the early 1970s to the present level of 110 cy/year. Industrial waste removed from the ABC facility was estimated at 48 cy/year between January 1985 and April 1996. A total of 24 cy of waste was removed from the RBC facility during its seven months of operation by Church & Dwight from January to July of 1985 (Mailing No. 9, pp. Supp000006-7). The waste material has been disposed of at the Auburn and Seneca Meadows landfills. Solid wastes which are transported to the Seneca Meadows Landfill are required to undergo Toxicity Characteristic Leachate Procedure (TCLP) testing at regular intervals, and at least once per year. Church & Dwight indicated in their first submittal that none of the solid industrial wastes generated at the site were considered hazardous (Mailing No. 1, p. 000112), except for some solvents and degreasers in the maintenance shop, one drum of paint thinner from the RBC facility, and spent reagents generated by the lab, all of which were disposed of separately. These wastes are summarized in Table 1 below.

Solid industrial wastes were also generated by the sodium carbonate monohydrate manufacturing process. Until the late 1960s, backwashed sand filters and mud consisting of sand and sodium carbonate were pumped into railcars behind the Willis Avenue Plant. Approximately six times per year, the railcars would be taken to the Allied property, and the material was disposed of by Allied. Beginning in 1970, this material was placed in the plant rubbish dumpsters, and disposed of along with the industrial wastes described above. In 1986, the plant switched to a leaf filter system using diatomaceous earth and carbon. The filter cake wastes were disposed of as industrial waste (Mailing No. 1, p. 000074).

On June 30, 1986, one drum of paint thinner accumulated during the Church & Dwight operation of the RBC facility in 1985 was removed and disposed of by Solvents and Petroleum Services, Inc. Solvents and degreasers used in the operation of the maintenance shop were supplied, manifested and removed by Safety-Kleen, Inc. Spent lab reagents were accumulated in a 35-gallon drum, manifested and removed for off-site disposal by Environmental Products and Services. Church & Dwight maintained status as a USEPA small quantity generator (NYD 002226892) for these wastes. During demolition of the RBC facility, bricks were disposed of as industrial waste, and steel was sent to scrap merchants. PCB capacitors were manifested and removed by National Electric, Inc. (Mailing No. 1, pp. 000890-000899), and Mayer Pollock Steel Corp. handled asbestos removal (Mailing No. 1, pp. 001276-001326).

Table 1: Summary of Generated Wastes

Waste Type	Est. Annual Quantity	Date or Period of Disposal	Disposal Site
Miscellaneous Industrial Waste	528 cy/yr	1896-1970	Allied Landfill (name and location not provided in the mailings)
Miscellaneous Industrial Waste	110-528 cy/yr	1970-2002	Seneca Meadows Landfill (Facility No. 50S08), Waterloo, NY City of Auburn Landfill (Facility No. 06S01), Auburn, NY
Spent Reagents	18-100 gal/yr	1989-2002	Environmental Products & Services, Inc. (NYD980761191), Syracuse, NY Frontier Chemical Waste Process, Inc. (NYD043815703), Niagara Falls, NY Solvents and Petroleum (NYD013277454), Syracuse, NY Pollution Solutions of Vermont (VTD982765537), Williston, VT Cyclechem, Inc. (NJD0002200046), Elizabeth, NJ City Environmental (MI0980991566), Detroit, MI
Process Wastewater	9-37 MG/yr (Willis Ave Plant)	1896-2002	Sanitary sewer
	2-13 MG/yr (ABC facility)	1985-1996	Sanitary sewer
Waste Oils	Not specified	Not specified	Safety-Kleen, Elgin, IL Environmental Products & Services, Inc. (NYD980761191), Syracuse, NY
Solvents and Degreasers	18-110 gal/yr	Not specified	Safety-Kleen, Elgin, IL
PCB Transformers and Capacitors	Not specified	1987	National Electric (KSD980964993), Coffeyville, KS

Source: Mailing No. 1, pp. 000073-000086.

Wastewaters were generated by several of the manufacturing processes used at all of the facilities. Some of the water was reused in the manufacturing process. Rinse water from the crystallizers in the manufacture of sodium carbonate monohydrate was recycled into the process. Equipment washdown from the sodium carbonate decahydrate manufacturing process was used as spray water in the production process, and waste liquor was reused in the monohydrate process. The equipment washdown from the manufacture of liquid laundry detergent and some of the floor washdown was recycled. All of the wastewater from the wet scrubbers in the sodium bicarbonate manufacturing process in the RBC facility were piped to the SFX facility as used in the sodium sesquicarbonate manufacturing process. Equipment washdown from the sodium sesquicarbonate process was captured in a sump and reused in the process (Mailing No. 1, pp.000073-000077).

Wastewater was discharged into the Metropolitan Syracuse Wastewater Treatment Plant (Metro), operated by the Onondaga County Department of Drainage and Sanitation (OCDDS), at two locations: Sewer No. 1 for the Willis Avenue Plant and Sewer No. 2 for the ABC facility. Condensed vapors and cooling water blowdown from the sodium carbonate monohydrate process, equipment washdown from the powdered detergent manufacture process, some of the floor washdown from the liquid laundry detergent manufacturing and packaging processes, and wastewater from the pilot plant and boiler house were discharged directly to Sewer No. 1 prior to 1987. A pretreatment system, controlling the pH and foam in the wastewater, was installed at the Willis Avenue Plant in 1987, and was expanded in 1989-90 and upgraded in 1993 (Mailing No. 1, p. 000068). The system consists of a series of mixing tanks designed to mix the effluent with a defoaming agent and sulfuric acid as necessary to adjust the pH of the effluent to be within 5.5 to 9.5 standard units, the range permitted by OCDDS Discharge Permit No. 94. The pretreatment system discharges to Sewer No. 1. Prior to 1989, spent lab reagents were emptied into sinks, and discharged to Sewer No. 1 (prior to 1987) or piped to the plant pretreatment system (after 1987). From 1989 to 2002, these wastes were accumulated and disposed of under contract by Environmental Products and Services. Annual discharges to Sewer No. 1 ranged from 37 million gallons per year (MG/yr) in 1987 to 15 MG/yr in 1999, based on metering (Mailing No. 9, p. SuppCD000022).

Equipment washdown and waste liquors from the wet air scrubber at the ABC facility were sent to Allied's soda ash plant until 1985, and were subsequently discharged under OCDDS Permit No. 94 to Sewer No. 2. Also in 1985, Church & Dwight installed a cooling tower in the ABC facility, and blow-down of the cooling tower water was discharged to Sewer No. 2. A pretreatment system was added to the ABC facility in 1992 and upgraded in August 1993. The water continued to be discharged to Sewer No. 2 after pretreatment, until operations at the ABC facility ceased in April 1996. Non-contact cooling water used in the sodium sesquicarbonate process, supplied by Allied, was returned to Allied and discharged under their New York State Pollutant Discharge Elimination System (SPDES) permit (Mailing No. 1, pp. 001326-001327). Wastewater discharged from the ABC facility, estimated from the quantity of metered water purchased, ranged between 13 MG/yr in 1989 and 1990 to 2 MG/yr in 1987. The plant is estimated to have discharged in excess of 72 MG of wastewater during its operation by Church & Dwight between January 1985 and April 1996 (Mailing No. 9, p. SuppCD000022).

Facility Permits

The permitted releases originating on-site were for air emissions (NYSDEC), stormwater discharges (NYSDEC), and sanitary, cooling water, and industrial waste streams discharged to the sanitary sewer system (OCDDS). These permits are discussed below.

Air emission permits were issued to Church & Dwight for 38 different emission points on the Willis Avenue Plant and the former Allied properties. Permits for emissions were granted to Church & Dwight (NYSDEC Location number 311500-0099) for the following emission points (EPs) and pollutants since 1970 (Mailing No. 1, pp. 000601-000869):

- EP 1: Willis Avenue Plant boiler stack (particulates, sulfur dioxide [SO_2], nitrous oxide [NO_x])
- EP 2: Process cooling air exhaust, Building 1 (particulates)
- EP 3: Monohydrate bagging screen, Building 8 (particulates)
- EP 4: Soda ash feeding point, unloading area (particulates)

- EP 5: Material (unidentified) loading point to silo, unloading area (particulates)
- EP 6: Packing plant exhaust, Building 1 (particulates)
- EP 7: Exhaust from transfer of powder from tote bins to hopper, Building 1 (particulates)
- EP 8: Premixing of moist material in sesquicarbonate process exhaust, Building 1 (particulates)
- EP 9: Exhaust from packaging of powdered laundry detergent, Building 1 (particulates)
- EP 10: Exhaust from blending of laundry detergent ingredients, Building 1 (particulates)
- EP 12: Exhaust from receiving hoppers for pneumatic conveyors, Building 1 (particulates)
- EP 13: Exhaust from conveyance of washing soda to packager, Building 10 (particulates)
- EP 14: Exhaust from transfer of laundry detergent to packaging, Building 10 (particulates)
- EP 15: Exhaust from baking soda package separating machine, Building 12 (particulates)
- EP 20: Exhaust from conveyance and packaging of baking soda, Building 12 (particulates)
- EP 21: Exhaust, Building 10 (particulates, ethoxylated alcohol, alcohol ethoxysulfate)
- EP 23: Exhaust from conveyance, blending and packing of carpet deodorizer and cat litter, Building 12 (particulates)
- EP 24: Exhaust from wastewater pH neutralization system
- EP AB1: Exhaust from carbonating column and absorber, ABC facility (ammonia, ammonium carbonate, carbon dioxide [CO_2])
- EP BC1: Exhaust from carbonating columns, RBC facility (particulates, carbon monoxide [CO], and CO_2)
- EPs BC2A, 2B and 2C: Exhaust of wet scrubber, RBC facility (particulates)
- EPs BC3A, 3B and 3C: Exhaust from curing bin, RBC facility (particulates, CO_2)

- EP BC4: Exhaust from bagging operations, RBC facility (particulates)
- EPs SF1, 2 and 3: Exhaust from wet-air scrubbers, SFX facility (particulates)
- EPs MT101-104, ST103, 105-107 (volatile organic compounds [VOCs], ethyl alcohol)

NYSDEC permits and/or permit applications were provided for all of the above emission points. Church & Dwight did not indicate if there ever were emission points numbered 11, 16-19, 22 or ST101, 102 or 104 and copies of the permits for these were not provided. The permit for emission point 20 was surrendered on December 21, 1998. The supplied permits for emission points 1 through 6, 8, 9, 10, 21 and AB1 were valid through May 15, 2001. No indication of whether those permits were renewed has been supplied by Church & Dwight (the last mailing from Church & Dwight is dated October 16, 2000). Permits for emission points MT101-104, ST103, and 105-107 appear to be current through August 31, 2001. Church & Dwight stated that no Notices of Violation associated with air emissions were issued by NYSDEC or USEPA (Mailing No. 1, p. 000109).

Until July 1985, Church & Dwight discharged wastewater and cooling water from the ABC facility through the Allied outfall to the East Flume, which discharges to Onondaga Lake. Allied maintained SPDES permit number NY0002275 for that outfall. After July 1985, wastewater and cooling water from the ABC facility were discharged to the sanitary sewer under OCDDS Permit No. 94 (discussed below). Church & Dwight applied for a SPDES permit for stormwater in 1985, but did not receive one due to regulatory extensions granted by USEPA (Mailing No. 1, p. 000110). In 1992, Church & Dwight filed a new SPDES permit application to replace the 1985 application, covering stormwater and treated discharge from the utility tunnel crossing Willis Avenue, and received draft SPDES permit number NY0157180. However, in 1993, NYSDEC notified Church & Dwight that a SPDES permit would not be required upon sealing of the utility tunnel, and that a general permit should be applied for instead (Mailing No. 1, p. 003926).

Church & Dwight applied for and received general permit GP-93-05, issued on July 14, 1993. SPDES general permit NYR00B073 was issued for the Willis Avenue site and permit

NYR00B133 was issued for the ABC site. The majority of the stormwater from the Willis Avenue site, including water from the roof drains, is discharged to the Allied storm drain, which in turn discharges to the East Flume. A total of 8.6 acres of land drains to this outfall. Stormwater from the eastern portion of the site, totaling 4.8 acres, drains to a marshy area, which in turn drains into Harbor Brook. Stormwater from the ABC site was discharged into the Allied storm drain. Church & Dwight filed a Notice of Termination for the ABC permit (NYR00B133) on June 6, 1996, after operations at that facility ceased. The general permit was renewed in 1998, renumbered GP-98-03, and expires on November 1, 2003. Church & Dwight did not report any Notices of Violation associated with their SPDES permits (Mailing No. 1, p. 000110).

Church & Dwight discharged sanitary and process wastewater to the municipal sewer system since the Willis Avenue Plant opened in 1896, and reports paying sewer use charges since 1977 or earlier. On November 25, 1987, OCDDS issued Industrial Wastewater Discharge Permit No. 94 to Church & Dwight, covering wastewater discharges into the sewer system from both the Willis Avenue Plant and the ABC sites. The permit was renewed in 1990, 1994, 1996, and 1999. The most recent permit was valid until September 10, 2002. The original permit allowed for the discharge of sanitary wastewater, boiler blowdown, process wastewater originating from the manufacturing of laundry detergent, wastewater from the cleaning of the filtration system in the monohydrate manufacturing process, and process wastewater from the manufacturing of ammonia bicarbonate at the ABC facility. Permit requirements include limiting the pH of the process wastewater from the detergent manufacturing process to between 5.5 and 9.5 standard units and a limit of 3 lbs/day and 10 lbs/week of diatomaceous earth filter material from the monohydrate process in the wastewater stream. Church & Dwight was also required by the terms of the permit to submit quarterly self-monitoring reports for the following parameters: biochemical oxygen demand (BOD), total suspended solids (TSS), total phosphorus (TP), pH, oil and grease (O&G), methylene blue active substances (MBAS), chemical oxygen demand (COD), ammonia (NH_3N), and total Kjeldahl nitrogen (TKN) in Sewer No. 1, and BOD, TSS, TP, pH, TKN, NH_3N, and magnesium (Mg) in Sewer No. 2 (Mailing No. 1, p. 001164).

The OCDDS permit was also modified several times, beginning in July 1991, to allow the discharge of treated PCB-contaminated water from the utility tunnel beneath Willis Avenue. The permit limited the contaminant concentrations in the discharge to 1 µg/L of PCBs, 20 µg/L of mercury, and 2 mg/L of purgeable aromatics. The utility tunnel was sealed in 1993, at which time the discharge of water from the tunnel ceased. Church & Dwight indicated that it had received several Notices of Violation (NOVs) and Compliance Orders for wastewaters discharged to the municipal sewer system. Notices of violation were issued on April 18, 1992, May 11, 1992, May 12, 1994, April 26, 1995, October 16, 1996, and July 16, 1999. The NOVs are discussed in Section 3.5.

Solid wastes from the Church & Dwight facilities were generally disposed of at one of two landfills, Seneca Meadows Landfill or the City of Auburn Landfill, since 1970. The wastes were transported by Rubbish Removal, Inc., of Syracuse, NY. Church & Dwight stated that their industrial wastes did not contain any RCRA-listed hazardous wastes (Mailing No. 1, p. 000112). Seneca Meadows Landfill, where the majority of the waste was disposed of, requires annual TCLP testing to ensure that the waste stream qualifies as non-hazardous. Church & Dwight supplied the results of TCLP testing, and the resulting Industrial Waste Approvals from Seneca Meadows, for the years 1992 through 1999 (Mailing No. 1, pp. 000214-000314, 000323-00425, 000525-00538).

Church & Dwight generated a small quantity of hazardous wastes, primarily spent reagents from the on-site laboratory and solvents and degreasers from the maintenance shop, and was registered as a USEPA Small Quantity Hazardous Waste Generator (NYD002226892). Spent laboratory reagents were manifested and removed by Environmental Products and Services, Inc. The annual quantity of such wastes varied between 18 and 110 gal/yr. Solvents and degreasers were supplied, manifested and removed by Safety-Kleen Corp. The annual volume of such wastes generated varied between 42 and 59 gal/yr. Church & Dwight stated that they have not received any Notices of Violation for their solid and hazardous waste handling procedures (Mailing No. 1, p. 000055). The facility was last inspected by NYSDEC on May 18, 1992.

Church & Dwight maintained New York State Radioactive Materials License Nos. 1909-1858 for an Ohmart SHRM-24 belt scale. The scale was in place from 1969 until 1988, although the license was in effect from 1969 until 1991. Church & Dwight did not report receiving any Notices of Violation associated with this permit (Mailing No. 1, p. 000113).

The Willis Avenue Plant was issued NYSDEC Hazardous Substance Bulk Storage Registration Certificate's for eight above-ground storage tanks (Mailing No. 1, p. 005517). The following is a summary of the registered and non-registered above-ground storage tanks at the Willis Avenue Plant that have a capacity of at least 185 gallons and contain hazardous substances:

- There was one 10,000-gallon storage tank containing Alkyl Ether Sulfate (Mailing No. 1, pp. 005640-005644) located north of Building 2.

- A 500-gallon tank containing sulfuric acid to be used during pilot testing, was installed in Building 3 (Mailing No. 4, p. 006964) in November 1997. The tank was removed in March 1998.

- Building 7 (Mailing No. 1, p. 005587) housed thirteen storage tanks with a total capacity of 136,400 gallons which contained sodium hydroxide, DBSA (alkylbenzene sulfonic acid), sodium silicate, non-ionic liquids, soft water, washout water, finished product, and brightener solution (Blankophor BBH). There were also two 350-gallon storage totes that were used to store detergent and bleach perfume (Mailing No. 1, pp. 005493-005494). On March 26, 1998, a 5,000-gallon tank containing sodium hydroxide was switched to sulfuric acid, and a 10,000-gallon DBSA tank was switched to sodium hydroxide (Mailing No. 5, p. 007025).

- Adjacent to Building 9, there was a 550-gallon outdoor storage tank containing No. 2 fuel oil that serves as a "Trackmobile Fuel Supply" (Mailing No. 1, p. 005579).

- Inside Building 10, there were five tanks with a total capacity of 59,000 gallons containing sulfuric acid, polyacrylate and non-ionic liquid. In the Building 10 Neutralization Area, there was one 750-gallon tank which contains sulfuric acid (Mailing No. 1, pp. 005532, 005533).

- The Willis Avenue Lab accumulated spent reagents such as toluene, acetone, chloroform and other solvents in a 35-gallon drum, and was considered a USEPA Small Quantity Generator for these wastes (Mailing No. 1, p. 000076).

3.0 POTENTIAL PATHWAYS FOR RELEASE OF HAZARDOUS SUBSTANCES TO THE LAKE SYSTEM

Church & Dwight supplied a 1996 Willis Avenue Plant Spill Prevention Report (SPR) which was prepared by C&S Engineers, Inc. (Mailing No. 1, pp. 005483-005670). In addition to general background site data, this document discusses the likelihood of spills and accidents, emergency response to spill procedures, and the system of inspections and reporting that have been implemented regarding spills. Based on information presented in the SPR, "liquids captured by floor drains are collected and treated in a series of wastewater treatment (neutralization) tanks" (Mailing No. 1, p. 005491). The treatment tanks also receive flow, in the event of a spill, from a sump that is located near Building 7 to the north of the truck off-loading area. In general, "waste water discharges are either pretreated and discharged to the municipal sewer system or are recycled" (Mailing No. 1, p. 000078). An Industrial Discharge Permit was issued by the OCDDS to allow treated effluent to be discharged into the municipal sanitary sewer system for final treatment at the Metro plant. The on-site Willis Avenue Plant wastewater pretreatment system serves to control effluent pH and foam levels (Mailing No. 1, pp. 000101, 003035-003071).

3.1 Soil

Soil on the Church & Dwight sites could potentially be contaminated through spills of the various materials used on site. The majority of the spills addressed in Church & Dwight's mailings occurred within the buildings on site, and were either contained within retaining devices designed to hold overflows or were captured by floor drains or sumps. The spills reported by Church & Dwight that appear to have likely directly impacted the soil, including spills of ammonia solution and fuel oil, are discussed below.

On July 9, 1991, Church & Dwight submitted a Remedial Action Plan to the NYSDEC for review and approval in response to an ammonia spill at the PotCarb facility (Mailing No. 1, p. 002446). The Remedial Action Plan was prepared by O'Brien and Gere on July 2, 1991. The ammonia spill occurred during the demolition of the Potassium Carbonate facility in

1991. Approximately 500 gallons of 7.9% ammonia solution were released onto the soil. The Remedial Action Plan proposed a soil tilling/aeration procedure to facilitate volatilization until the residual ammonia concentrations in the soil were less than 500 mg/kg (Mailing No. 1, p. 002449). Church & Dwight indicated that the cleanup proceeded according to the Work Plan (Mailing No. 1, p. 000094). Although the Work Plan indicated that verification sampling would be performed, no results were provided.

On June 13, 1995, C& S Engineers submitted a Spill Response Report (NYSDEC Spill File No. 94-1578) in response to a suspected fuel oil spill at the Willis Avenue Plant. Fuel oil was found to have contaminated the soil in two locations, the north side of the boiler house (NYSDEC Spill No. 9307727) and beneath Buildings 4 and 7 (Spill No. 9415768). The contaminated soil (100 cy) near the boiler house, discovered during the removal of underground fuel storage tanks, was excavated and removed from the site, as described in Section 4.1 of this report. The information provided for review did not indicate if any post-excavation verification sampling was performed.

On June 13, 1995, C&S Engineers submitted an Environmental Response Report summarizing the findings of the investigation of stained soil at the Willis Avenue site exhibiting an odor similar to fuel oil. Soil samples were collected and analyzed for VOCs (USEPA Method 8021) and semi-volatile organic compounds (SVOCs, USEPA Method 8270). The soil beneath Buildings 4 and 7 was discovered to be contaminated with petroleum during the installation of a pile foundation for new equipment at the Willis Avenue Plant. It was determined that portions of the soil below the concrete slab of the building exceeded NYSDEC Spill Technology and Remediation Series (STARS) guidance values for VOCs and SVOCs (Mailing No. 1, p. 002395). C&S Engineers, Inc., concluded that the contamination was not migrating, and that any future migration of the organics would be limited by existing concrete structures. NYSDEC accepted C&S Engineers' determination that no further action was necessary (Mailing No. 1, p. 000092), as described in Section 4.1 of this report. As a result, this contaminated soil has remained in place.

3.2 Surface Water

Stormwater Pollution Prevention Plans (SWPPP) were prepared by C&S Engineers, Inc. (Mailing No. 1, pp. 003670-003890) for the Willis Avenue Plant (1995 and 1996) and the ABC site (1995 only). These documents summarize potential pollution sources, control measures to prevent off-site runoff contamination, and Superfund Amendments and Reauthorization Act (SARA) facility requirements. The description of potential pollution sources includes additional storage facilities such as tank trucks, rail cars and dumpsters, and loading/unloading areas in the Willis Avenue Plant (Mailing No. 1, pp. 003683-003686, 003785-003790).

"Significant materials," as defined by 40 CFR 122.26(b)(12), stored or handled within the drainage area of the plant, include sodium carbonate (soda ash), No. 2 diesel fuel, sulfuric acid, polyacrylate, DBSA, sodium silicate, sodium hydroxide, and Neodol MOD-3 and MOD-7. According to the SWPPP, the unloading of these materials is performed within designated areas, typically on concrete pads with a drainage trough to contain spills, using procedures designed to minimize spills (Mailing No. 1, pp. 003683-003686, 003785-003790).

Based on information presented in the SWPPPs, "the majority of the storm water from this facility flows to the Allied storm sewer system" (Mailing No. 1, p. 003676) that discharges to the East Flume of Onondaga Lake. Church & Dwight indicated that "stormwater runoff from the undeveloped eastern portion of the facility property discharges into Harbor Brook, which ultimately flows into Onondaga Lake" (Mailing No. 1, p.003775). The location of the East Flume and Harbor Brook is shown on Figure 1. Both the Willis Avenue and ABC facilities have a runoff collection system of roof drains, catch basins, swales and storm sewers, and have been issued a NYSPDES General Permit for Stormwater Discharges Associated with Industrial Activities. USEPA Form R reports from Church & Dwight indicate that 2,000 lbs of ammonia were released with stormwater from the ABC site in 1992, 23 lbs in 1995, and 7 lbs in 1996 (Mailing No. 9, pp. SuppCD 000235-000261).
Three discharge points labeled outfall 01S, 02S and 03S service the Willis Avenue Plant. Figure 4 is a site drainage plan for the Willis Avenue Plant, which indicates the locations of the stormwater outfalls. Outfall 01S service the majority of the stormwater runoff from the

site, including roof drains. Outfall 01S drains toward the west, to the main storm sewer servicing the AlliedSignal complex (Mailing No. 1, p. 003778). Potential materials which were used, stored, or transferred in outfall 01S drainage areas include sodium carbonate from railroad cars, No. 2 diesel fuel from an above-ground storage tank, sulfuric acid in a truck unloading area, polyacrolyte from tank trucks, sodium silicate from tank trucks, sodium hydroxide from tank trucks, Neodol MOD-7 and MOD-3 from rail cars, and an above-ground storage tank that is used as a wastewater bypass collection tank for the pH adjustment system (used during the period when the process effluent from the pH adjustment system exceeds pH limits) (Mailing No. 1, pp. 003786, 003789). Reportable spills associated with these storage areas are discussed in Section 4.1. Outfall 02S is a drainage swale which runs parallel to the railroad tracks along the southeast portion of the property. This swale collects stormwater from the eastern portion of the Willis Avenue Plant site, including the railroad tracks. The swale discharges down an embankment into a marshy area. This area is believed to drain into Harbor Brook (Mailing No. 1, p. 003778). There were no materials stored in outfall 02S drainage areas. Outfall 03S services the loading area located in the northwest portion of the Willis Avenue site. There were no materials stored in outfall 03S drainage areas.

Figure 5 illustrates the drainage patterns and outfall locations for the ABC site. Four stormwater inlets (outfalls 002, 003, 004 and 04I) that service the ABC site discharge stormwater from the roof drains of the SFX facility and warehouse, facility grounds and paved areas, and upgradient (off-site) flows from unspecified sources. Outfall 002 discharges stormwater from an area adjacent to the west side of the SFX facility. Outfall 003 discharges stormwater from the west side of the facility property and from off-site locations west of the facility. Outfall 004 discharges stormwater from the ABC facility as well as stormwater from the roof drains at the warehouse and SFX facility. Off-site sources east and south of the ABC site and off-site stormwater runoff from outfall 04I are also discharged to outfall 004. The outside storage tanks and the potential stormwater contaminants which are stored in tanks within the ABC site's storm drain system are two carbon dioxide horizontal tanks (50 tons), ammonium bicarbonate liquor tank (6,000 gallons), anhydrous ammonia tank (12,750 gallons), ammonium hydroxide tank (11,750

gallon), and sulfuric acid tank (500 gallons). Reportable spills associated with these storage structures are discussed in Section 4.1. Outfall 04I accepts off-site stormwater runoff and this outfall was utilized to determine background pollutants included in the discharge from outfall 004.

3.3 Groundwater

The direction of groundwater flow from the Church & Dwight properties is north to north-westerly, towards Onondaga Lake (Mailing No. 1, p. 002603). Consequently, groundwater provides a direct path for pollutants to the lake. Church & Dwight provided copies of two separate groundwater assessment reports which were prepared in 1988 and 1992 on their behalf (Mailing No. 1, pp. 002519-002676). The Groundwater Assessment report (O'Brien & Gere, March 1988) includes the results of investigations at three separate areas on the Church & Dwight and Allied Chemical properties. An investigation was conducted at the Cooper Building area (former Grief Brothers property) within the Allied Chemical facility to provide Church & Dwight with the groundwater quality data prior to their purchase of the property. An investigation was also conducted at the ABC site to identify potential sources of ammonia previously detected within groundwater. A third investigation was performed at the Willis Avenue Plant to determine if activities at the facility have had an impact on the groundwater quality at the site (Mailing No. 1, p. 002596). The extent of contamination is discussed in Section 4.2.

O'Brien & Gere performed groundwater investigations at the Willis Avenue Plant in 1987 and 1988. At the time, Church & Dwight was considering the purchase of the Greif Brothers property, also known as the Allied Cooper Building area (Mailing No. 1, p. 000095). The results of these investigations led O'Brien & Gere to conclude that the ABC facility is the likely source of elevated levels of ammonia, chloride, and dichlorobenzene in the groundwater. However, methyl tertiary butyl ether (MTBE) was also detected in the groundwater, causing O'Brien & Gere to suggest that the source of the dichlorobenzene may be a gasoline storage tank upgradient of the ABC site (Mailing No. 1, p. 002608). O'Brien & Gere suggested that an inventory of all chemicals used at the sites be prepared, and that

testing for additional inorganic parameters, e.g., heavy metals, might be necessary. However, Church & Dwight did not provide any documentation of any follow-up action on these recommendations. Groundwater in the vicinity of the Willis Avenue Plant site contained elevated levels of total dissolved solids, chloride, alkalinity, and phosphorus (Mailing No. 1, p. 002610). The contaminants found in samples from the Willis Avenue Plant site are believed to be the result of overflow from the brine reservoir located just south of the facility.

In 1992, O'Brien & Gere performed a groundwater investigation for Church & Dwight as a result of PCBs that were discovered in the groundwater seeping into the utility tunnel beneath Willis Avenue. The findings of this report were presented in the Site Investigation report dated July 15, 1992 and are discussed in Section 4.2 herein. Church & Dwight maintains that these PCBs are likely the result of spills by Allied prior to Church & Dwight's ownership of the tunnel and the RBC facility, as there did not appear to be any Church & Dwight-related on-site sources of PCBs (Mailing No. 1, p. 000097). Church & Dwight indicated that the on-site transformers owned by Niagara Mohawk were "dry" type transformers. Fourteen PCB-filled capacitors were located on site from 1974 until they were removed in 1981, at which point they showed no visible evidence of rupture or leakage (Mailing No. 1, p. 000097). Church & Dwight repiped the utilities running through the tunnel, and then filled the existing tunnel with a flowable fill (sand/cement mixture) to prevent further seepage. The results of the analysis were not conclusive in identifying the source of the PCBs in the groundwater (Mailing No. 1, p. 000095).

3.4 Air

Air permits for the Willis Avenue Plant indicate that there have been emissions of many contaminants, including ammonia, ammonium carbonate, sesquicarbonate, trisodium phosphate, tripolyphosphate, sodium perborate, sodium carbonate, soda ash, dry hydrous disilicate, alkyl aryl sulfonate, sodium carboxymethal cellulose, optical brightener/perfume, sodium silicate, linear alkyl sulfonate, alcohol ethoxysulfate, and carbon dioxide. The most frequent discharge based on these forms (Mailing No. 1, pp. 000601-000862) was sodium

carbonate. An area map showing the discharge locations was provided (Mailing No. 1, pp. 000820-000823).

Church & Dwight supplied USEPA Form R reports of emissions for ammonia, glycol ethers, sulfuric acid, and sodium sulfate, covering the years 1987 through 1996, and provided a summary of emissions (Mailing No. 9, pp. Supp000016-17). For ammonia, an average of 10,640 lbs/yr of fugitive emissions was reported from the ABC facility, although this average is skewed by the reported emission of 33,000 lbs in 1987 and 63,000 lbs in 1988. Between 1989 and 1996, emissions ranged between 450 and 1,673 lbs/yr. Stack emissions averaged 64,934 lbs/yr, but were again skewed by significantly greater emissions in certain years (206,000 lbs, 111,400 lbs, and 99,890 lbs in the years 1987 through 1989, respectively, as compared to a range of 10,319 to 50,509 lbs/yr from 1990 to 1996).

At the Willis Avenue Plant, fugitive emissions of glycol ethers averaged 1,143 lbs/yr from 1987 to 1992, ranging from 0 to 1,962 lbs/yr. Stack emissions were reported to average less than 500 lbs/yr. Fugitive emissions of sulfuric acid were reported as less than 500 lbs/yr from 1987 through 1990, and stack emissions were reported as less than 500 lbs/yr from 1987 through 1990, 6 lbs in 1991, and 0 lbs/yr for 1992, 1993, and 1994. No reports were prepared for 1995 and 1996. Fugitive emissions of sodium sulfate were reported as less than 500 lbs in 1988. No reports for sodium sulfate were prepared for 1987 and 1989 through 1996 (Mailing No. 9, pp. Supp000016-17).

3.5 County Sewer System

Church & Dwight has historically discharged industrial and sanitary wastewater through Sewer Nos. 1 and 2 to the OCDDS system since the Willis Avenue Plant opened in 1896. Since November 25, 1987, this wastewater was discharged under OCDDS Industrial Wastewater Discharge Permit No. 94. Permit No. 94 covered wastewater discharges into the sewer system from both the Willis Avenue Plant and the ABC facilities as well as the discharge of treated groundwater from the Willis Avenue utility tunnel. The permit was renewed in 1990, 1994, 1996, and 1999. The most recent permit was valid until September

10, 2002. Wastewater was continuously monitored for compliance with conditions of the OCDDS permit limiting the pH of plant effluent (Mailing No. 1, pp. 003036-003071). NOVs of the OCDDS permit were provided and are discussed below.

Sanitary wastewater, boiler blowdown, wastewater from the cleaning of the filtration system in the monohydrate manufacture process, process wastewater from the manufacture of laundry detergent and ammonia bicarbonate, and treated groundwater from the Willis Avenue utility tunnel were discharged to the sewer system. Since 1987, process wastewaters from the Willis Avenue Plant were pre-treated before discharge to the sewer to regulate pH and foam. Discharges from the ABC facility were pre-treated beginning in 1992. The primary contaminants discharged via the sewer system have been ammonia, sodium sulfate, and glycol ethers. USEPA Form R submittals indicate that an annual average of 395,732 lbs of ammonia were discharged to the sewer system from 1987 through 1996, with annual totals ranging between 63,068 and 696,641 lbs. In addition, an average of 744 lbs/yr of glycol ethers were discharged to the sewer system from 1987 through 1992, with annual totals ranging between 650 and 854 lbs. A total of 89,800 lbs of sodium sulfate were also discharged to the sewer system in 1988. Industrial wastewater surcharge data from 1987 through 1995 were provided in the mailings. Combined sanitary/industrial wastewater flows ranging from 23,400 gallons per day (gpd) to 100,000 gpd and 6,400 gpd to 35,300 gpd were discharged from the Willis Avenue Plant and ABC facilities, respectively (Mailing No. 1, pp. 003481-003628).

As noted in Section 2.3, Church & Dwight received several NOVs related to their discharge of wastewater to the sewer system. The April 18, 1992 NOV was issued due to excursions of the permitted PCB concentration in the utility tunnel groundwater discharge on January 16 and 30, 1992 (see Section 4.2.1 herein for groundwater results). Church & Dwight replaced the carbon filters on the PCB pretreatment system. Church & Dwight was also required to supply 24-hour turnaround on testing of water samples from the carbon filtration system, report results to OCDDS immediately, and apply for a SPDES permit to include the utility tunnel groundwater. The SPDES application was withdrawn in 1993, as noted above, when the utility tunnel was sealed (Mailing No. 1, pp. 000111-000112).

The May 11, 1994 NOV was the result of pH excursions in the wastewater stream. Church & Dwight agreed to upgrade the wastewater pretreatment process to prevent future pH excursions. The May 12, 1994 Compliance Order directed Church & Dwight to develop a plan for reducing nitrogen (TKN) in the ABC facility's wastewater stream. That order was modified on April 26, 1995, indicating that Church & Dwight would cease discharging process wastewater to the sewer system by June 1, 1996. The ABC facility ceased operation in April 1996 (Mailing No. 1, p. 000112).

The October 16, 1996 NOV was the result of a pH excursion on October 13, 1996. The excursion was caused by a faulty pH probe, which was replaced. No further action was required by OCDDS (Mailing No. 2, p. 006667). The July 16, 1999 NOV was the result of two unrelated pH excursions on June 3 and June 21, 1999. The first excursion was the result of a leaky valve, and the second excursion was the result of the failure to reset alarm limits on the pH control apparatus after calibration. Both problems were remedied, and OCDDS required no further action (Mailing No. 8, pp. 007395-0007396).

4.0 LIKELIHOOD OF RELEASE OF HAZARDOUS SUBSTANCES TO THE LAKE SYSTEM

4.1 Documented Releases

Documented Spills

Church & Dwight identified fourteen specific spills or releases of material at their facilities. The releases include ammonia (three times), ammonium bicarbonate and aqueous ammonia, mercury, fuel oil (twice), powdered laundry detergent, ethoxylated alcohol, polyacrylic acid, sulfuric acid (twice), and alkyl ether sulfate. Drawings indicating the locations of the various spills over time were supplied by Church & Dwight, and are attached herein as Figure 6 for the Willis Avenue Plant and Figure 7 for the ABC and SFX facilities.

Approximately 200 gallons of ethoxylated alcohol overflowed a mix-tank in Building 10 of the Willis Avenue Plant on March 1, 1998 (Mailing No. 1, p. 000092). The spill was released into the drain and the Church & Dwight pretreatment system, and from there to the sanitary sewer. OCDDS was notified of the spill on March 2.

A non-reportable spill of alkyl ether sulphate occurred in the pump room in Building No. 7 of the Willis Avenue Plant on or about June 1, 1996 (Mailing No. 1, p. 000093). The spill, totaling approximately 2,000 gallons, overflowed the containment system, resulting in the release of some of the material on the ground near the railroad tracks. The spill was cleaned up by Environmental Products and Services and reported to NYSDEC.

A spill of sulfuric acid occurred on May 14, 1995 near the sulfuric acid tank in the non-ionic portion of Building 10. The leak was the result of a faulty connector on the delivery truck. The spill was cleaned up by the supplier, and the material was disposed of as industrial waste. The spill was not reported to any government agencies (Mailing No. 1, p. 000093).

During the installation of piles in Buildings 4 and 7, fuel oil-contaminated soil was encountered on March 6, 1995 (Mailing No. 1, p. 000091). The spill was reported to NYSDEC (spill 9415768), and the foundation installation continued with additional field monitoring. Auger cuttings from the pile installation procedure were analyzed and found to contain volatile and semi-volatile organic compounds exceeding guidance levels. Church & Dwight's engineer, C&S Engineers, Inc., indicated in a report to NYSDEC (Mailing No. 1, pp. 002391-002427) that the contaminants were not migrating, and that any future migration would be limited by the existing concrete foundation and the channel lining of the nearby Erie Canal. In a letter dated July 20, 1995 (Mailing No. 1, p. 002428), NYSDEC accepted C&S Engineers' determination that the impacted area could not be "practically or economically further remedied" (Mailing No. 1, pp. 002395, 002396), and classified the spill as inactive and responded that "no further remediation or investigation is required nor contemplated."

During removal of two 25,000-gallon underground No. 6 fuel storage tanks on September 23, 1993, soil contaminated with fuel oil was discovered on the north side of the Willis Avenue Plant boiler house, and was reported to NYSDEC (spill 9307727). A tank close-out report prepared by C&S Engineers, Inc. (Mailing No. 1, pp. 002308-002343) indicates that the soil was most likely contaminated as the result of maintenance operations on the tanks, as no perforations or rust spots were found during a visual inspection of the tanks. Soil which exhibited evidence of contamination, based on odors and visual inspection, was excavated and removed from the site. It should be noted that there is a discrepancy on the total volume of soil removed; Church & Dwight's response to Question 9(b) of the 104(e) questionnaire indicates that 100 cubic yards (cy) were removed, whereas the C&S report to NYSDEC indicates 125 cy were removed. Invoices for shipping and disposal were completed on a weight basis, indicating that 164.33 tons of material were disposed. Church & Dwight was required to test the remaining soil after excavation to ensure complete removal. The soil samples were analyzed for USEPA Methods 8021 (VOCs) and 8270 (SVOCs, base/neutrals) after undergoing TCLP extraction. Results of laboratory testing indicate that no volatile or semivolatile analytes were found above detection limits, except

for chloroform in one sample, which is believed to be a laboratory contaminant (Mailing No. 1, p. 002312).

A mercury spill in Building 10 was discovered during a maintenance operation on August 28, 1992 (Mailing No. 1, p. 000091). The mercury spill originated from a manometer on a level gauge in the non-ionic area of the building, and was isolated in a floor trench. Environmental Services of Syracuse, NY was contracted to clean up the spill. Wastes, including the spill, clean-up materials, and used paint cans from the maintenance shop, resulted in two 55-gallon drums which were manifested and removed by Environmental Products and Services. According to Church & Dwight, TCLP analysis of the waste indicated that it was non-hazardous, but it was handled as hazardous waste due to freestanding mercury within the debris (Mailing No. 1, p. 000091). The incident was not reported to any government agencies.

Anhydrous ammonia was released to the atmosphere on the morning of April 9, 1992, when a safety relief valve was enabled in the southwest corner of the ABC plant (Mailing No. 1, p. 000093). Church & Dwight indicated that the release was not reported to any government agencies because the amount involved (15 lbs) was less than the CERCLA reportable quantity of 100 lbs/day. The cause of the spill was not determined.

On February 10, 1992, Church & Dwight reported an unplanned discharge of sanitary waste containing ammonium bicarbonate and aqueous ammonia from the ABC facility into the Allied storm drain, apparently caused by a blocked sanitary discharge line. After being informed by Allied of elevated ammonia levels in the East Flume around the same time the sanitary discharge line was blocked, Church & Dwight reported the spill to NYSDEC. A consent decree between NYSDEC and Church & Dwight required increased maintenance and inspection of the discharge line and payment of a fine (Mailing No. 1, p. 000090).

On June 22, 1991, a release of approximately 500 gallons of 7.9% ammonia solution occurred during the course of building demolition at the Armand Products site in Solvay. The spill was reported to NYSDEC. Church & Dwight remediated the soil to an ammonia

concentration of less than 500 mg/kg by tilling the soil repeatedly, allowing for a reduction in the ammonia concentration through volatilization to the atmosphere (Mailing No. 1, pp. 002446-002453).

On April 29, 1990, a spill of approximately 4,300 gallons of polyacrylic acid occurred within the storage building of the Willis Avenue Plant (Mailing No. 1, p. 000092). The majority of the spill was held in a containment unit, and the pH was adjusted using soda ash, which was then disposed of in open-top garbage containers. The portion of the acid that entered the drain was neutralized using the pretreatment system and then discharged to the sewer. OCDDS was notified and did not report experiencing any problems related to the spill.

On February 20, 1989, sulfuric acid was inadvertently spilled when a truck driver washed out the hoses used to deliver the acid on the ground (Mailing No. 1, p. 000093). The acid was discharged to the sanitary sewer line, resulting in a pH excursion that lasted 10 minutes. OCDDS was notified of the incident.

A release of powdered laundry detergent occurred in 1989 or 1990, when a baghouse dust collector malfunctioned (Mailing No. 1, p. 000092). Laundry detergent product was released, causing several of Church & Dwight's neighbors to complain. Church & Dwight dispatched maintenance workers to assist in the removal of detergent from nearby cars and roofs.

An ammonia release occurred on July 24-25, 1988 near the ABC facility (Mailing, No. 1, p. 000090). An apparently faulty release valve on a railcar carrying ammonia to the ABC facility caused the release of an estimated 100 to 500 lbs of ammonia to the atmosphere between 4:23 AM on July 24 and 6 AM on July 25. Church & Dwight recorded atmospheric ammonia concentrations of 0 ppm and 5 ppm at the Willis Avenue Plant and ABC sites, respectively, and 20 ppm in the vicinity of the railcar. Church & Dwight notified the National Response Team, NYSDEC, and Onondaga County Division of Emergency Management, and transferred the ammonia from the leaky railcar to another nearby railcar. No further action was taken.

A release of baking soda occurred in the early 1930s (Mailing No. 1, p. 000093). Church & Dwight provided no details regarding the release, although a lawsuit brought by the owner of a neighboring property was settled.

Ongoing/Recent Releases

There are no ongoing releases due to the demolition of the Willis Avenue facility.

4.2 Threat of Release to the Lake System

4.2.1 Extent of Site Contamination

Based on the material submitted, soil contamination exists beneath the Willis Avenue Plant and near the Willis Avenue utility tunnel, and groundwater contamination exists in the vicinity of the ABC site and near the Willis Avenue utility tunnel.

Soil

Soil beneath Buildings 4 and 7 was found to be contaminated with fuel oil during the installation of a pile foundation. Samples collected from soil underlying Building 4 exceeded the NYSDEC STARS guidelines (guidance values in parentheses) for the following VOC analytes: 26,000 µg/kg (ppb) of naphthalene (200 µg/kg), 11,000 µg/kg of 1,2,4-trimethylbenzene (100 µg/kg), 3,600 µg/kg of 1,3,5-trimethylbenzene (100 µg/kg), 2,100 µg/kg of o-xylene (100 µg/kg), and 5,100 µg/kg of m-xylene (100 µg/kg). Concentrations of ten PAHs also exceeded NYSDEC STARS guidance values, including phenanthrene at a concentration of 59,000 µg/kg in excess of the 1,000 µg/kg guidance value. These data and the guidance values are included in Church & Dwight's Mailing No. 1 (p. 002399).

As part of an investigation to identify the presence of PCBs in the groundwater in the vicinity of the Willis Avenue utility tunnel, O'Brien & Gere collected six soil samples from three

borings in May 1992. PCBs were not detected in the soil samples (less than 0.7 ppm) (Mailing No. 1, p. 002505). However, the laboratory reports indicate that mercury was detected in soil at a concentration of 27 ppm from 2 to 4 feet below ground surface at boring location B-3. The locations of the borings were not shown in the figures included with the July 15, 1992 O'Brien & Gere report. However, the boring logs indicate that boring B-1 was installed on the west end of the railroad spur, B-2 was installed at the middle of the railroad spur, and B-3 was installed at the east end of the railroad spur. Concentrations of mercury in the other soil samples ranged from 0.9 ppm to 2.0 ppm. The NYSDEC recommended soil cleanup objective (RSCO) for mercury is 0.1 ppm. The O'Brien & Gere report did not discuss the presence nor the source of the elevated mercury. Other metals were also detected at elevated concentrations including: arsenic up to 78 ppm (RSCO of 7.5 ppm), chromium up to 27 ppm (RSCO of 10 ppm), copper up to 140 ppm (RSCO of 25 ppm), nickel up to 43 ppm (RSCO of 13 ppm), and zinc up to 120 ppm (RSCO of 20 ppm) (Mailing No. 1, p. 002505).

As indicated in Section 1.2 of this report, O'Brien & Gere indicated that there is between 5 and 15 feet of fill material in the vicinity of the ABC facility that consists of "layers of gravel, sand and cinders and a grayish white powdery ammonia bicarbonate sludge" (Mailing No. 1, p. 002603). Soil data from this area were not included in the documents available for review.

Groundwater

Groundwater was found to be contaminated in several locations. Groundwater samples from the area surrounding the Willis Avenue utility tunnel contained elevated levels of PCBs. Groundwater at the ABC facility was found to contain elevated levels of ammonia, chloride, and dichlorobenzene, and groundwater in the vicinity of the Willis Avenue Plant exhibited elevated levels of alkalinity, phosphorus, chlorides, and total dissolved solids.

Groundwater samples were obtained from several wells in the vicinity of the Willis Avenue utility tunnel. A map showing these locations and the PCB concentrations was supplied by

Church & Dwight (Mailing No. 1, p. 002463) and is included herein as Figure 8. According to the text of the report prepared by Church & Dwight's engineer, O'Brien & Gere (Mailing No. 1, pp. 002458-002508), analytical results should have been supplied as Attachment C of the report, however, these data tables were not included in the mailing. Concentrations of PCBs ranging between 0.1 µg/L (ppb) and 0.4 µg/L were detected in three of the wells sampled. The NYSDEC Class GA groundwater standard for total PCBs is 0.09 µg/L. Church & Dwight indicated in their submittal that water from within the utility tunnel itself had PCB concentrations up to 2.8 µg/L (Mailing No. 1, p. 002463).

Elevated levels of dichlorobenzene, ammonia, and chlorides were discovered in groundwater in the vicinity of the ABC facility. Elevated levels of chlorides, total dissolved solids, alkalinity, and phosphorus were found in groundwater in the vicinity of the Willis Avenue Plant. A groundwater contour map, also showing the locations of the wells sampled at both sites, was supplied by Church & Dwight (Mailing No. 1, p. 002622) and is included herein as Figure 9. The vertical datum of the groundwater elevations shown on Figure 9 was not indicated on the figure. In the vicinity of the ABC facility, a 1,4-dichlorobenzene concentration of 220 ppb was detected in MW-204, exceeding the NYSDEC Class GA groundwater standard of 3 ppb. Chloride ranged from 170 ppm at MW-204 to 610 ppm in MW-202, exceeding the NYSDEC Class GA standard of 250 ppm. Ammonia was detected at levels ranging from 3.4 ppm at MW-204 to 160 ppm at MW-203 (Mailing No. 1, pp. 002613-002618), exceeding the NYSDEC Class GA standard of 2 ppm.

At the Willis Avenue Plant site, chlorides ranged from 400 ppm at MW-301 to 13,000 ppm at MW-304, exceeding the NYSDEC Class GA groundwater standard of 250 ppm. In addition, downgradient concentrations of alkalinity, phosphorus, total dissolved solids, and chlorides exceeded upgradient concentrations (Mailing No. 1, pp. 002613-002618).

Surface Water

Church & Dwight did not indicate that they have collected and analyzed surface water samples from the East Flume or Harbor Brook. Only one report involving the discharge of polluted water to Onondaga Lake or one of its tributaries was submitted, namely, the February 10, 1992 report to NYSDEC that documents a release of ammonium bicarbonate and aqueous ammonia into Allied's storm drain. The release was the result of a blockage in a sanitary sewer line. Part of the settlement between NYSDEC and Church & Dwight to resolve the issue called for weekly inspections of the sanitary sewer in addition to regular cleaning to prevent a recurrence (Mailing No. 1, p. 000090). These procedures appear sufficient to prevent further releases to the lake via surface water, as no further reports of similar violations have been made. The monitoring of the SPDES-permitted outfall in the East Flume has been conducted by Honeywell (formerly AlliedSignal). Church & Dwight collected and analyzed stormwater samples from the on-site outfalls 01S, 02S, and 03S (as described in Section 3.2) in 1992 and 1994 as part of the Stormwater Pollution Prevention Plan (C&S, September 1995, Mailing No. 1, pp. 003771-003890). These samples were only analyzed for conventional parameters and not TCL/TAL parameters.

Sewer Discharges

As stated in Section 2.3, Church & Dwight maintained an industrial wastewater discharge permit with OCDDS, which had at various times permitted the discharge of sanitary wastewater, boiler blowdown, process wastewater originating from the manufacture of laundry detergent, wastewater from the cleaning of the filtration system in the monohydrate manufacture process, process wastewater from the manufacture of ammonia bicarbonate at the ABC facility, and treated groundwater from the Willis Avenue utility tunnel. The primary contaminants discharged via the sewer system have been ammonia, sodium sulfate, and glycol ethers.

USEPA Form R submittals indicate that an annual average of 395,732 lbs/yr of ammonia were discharged to the sewer system from 1987 through 1996, 744 lbs/yr of glycol ethers were discharged to the sewer system from 1987 through 1992, and a total of 89,800 lbs of sodium sulfate were discharged to the sewer system in 1988 (Mailing No. 9, pp. SuppCD

000235-000261). Relative aqueous concentrations of each of these pollutants were not provided by Church & Dwight. Wastewater from the Willis Avenue Plant was pretreated for pH and to limit foaming since 1987, and wastewater from the ABC facility was similarly treated from 1992 until closure.

4.2.2 Migration Potential of Contaminants

The potential contaminants of concern at the Church & Dwight sites include volatile and semi-volatile organics, PCBs, and ammonia. Volatile and semi-volatile organic compounds were found in the soil beneath Buildings 4 and 7 of the Willis Avenue Plant. Church & Dwight's engineers, C&S Engineers, Inc., determined that the potential for migration of these pollutants was limited by the presence of concrete foundation walls and the channel lining of the Erie Canal. Therefore, the potential for migration of these pollutants was considered minimal (Mailing No. 1, pp. 002395-6). A 1994 Compliance Order required Church & Dwight to develop a plan to reduce concentrations of nitrogen (TKN) in wastewater from the ABC facility to prevent lake eutrophication as part of the overall Onondaga Lake cleanup efforts. The order also required Church & Dwight to develop a plan for source reduction opportunities for ammonia at the ABC facility. Some reductions in ammonia were achieved prior to closure of the ABC plant in April 1996.

A semi-volatile organic compound, 1,4-dichlorobenzene, was found in the groundwater just west of the ABC facility. The flow of groundwater from this location is north or northwest, toward Onondaga Lake. Church & Dwight's engineer, O'Brien & Gere, did not identify any aquitards or other obstructions to prevent the contaminant from entering the lake, although the groundwater velocity is anticipated to be low due to fine-grained soils (Mailing No. 1, p. 002610). It is noted that a source of chlorinated benzenes exists west of the ABC facility in an area known as the "Chlorobenzene Hot Spot Area" that is being investigated as part of Honeywell's Willis Avenue Site Remedial Investigation (O'Brien & Gere, 1999).

PCBs were found in the groundwater surrounding the Willis Avenue utility tunnel at varying concentrations up to 0.4 ppb and in the tunnel at a concentration of 2.8 ppb. Although the

utility tunnel was sealed and the utilities were relocated to prevent further seepage of PCB-contaminated groundwater into the tunnel, it is believed that Church & Dwight did not conduct any further investigations of PCB-contaminated groundwater nor did they identify or control the source of the PCBs. Church & Dwight indicated that the PCBs are likely the result of activities by Allied prior to Church & Dwight assuming ownership of the various former Allied properties (Mailing No. 1, p.000097). Thus, it is possible that PCB-contaminated groundwater from this area is migrating toward the lake.

5.0 POTENTIAL FOR ADVERSE IMPACTS TO LAKE SYSTEM DUE TO A RELEASE OR THREAT OF A RELEASE

5.1 Hazardous Substance Characteristics

As summarized in Section 4.2.2, the potential contaminants of concern for the Church & Dwight sites, based on the documents provided by Church & Dwight, are VOCs (1,4-dichlorobenzene), SVOCs (PAHs), PCBs, and ammonia. A discussion of hazardous substance characteristics is provided below for these parameters.

Mobility

Benzene and other VOCs rapidly volatilize into the atmosphere where photo-oxidation produces hydrochloric acid, carbon monoxide, carbon dioxide, and carboxylic acid (USEPA, 1979). In surface waters, dissolved VOCs will rapidly volatilize into the atmosphere where photo-oxidation will occur. In soil, benzene and other VOCs are considered mobile under most subsurface conditions and will readily leach into groundwater.

Semi-volatile organic compounds, especially PAH-type compounds, have relatively low mobilities. Polycyclic aromatic hydrocarbons are a class of compounds containing two or more aromatic (benzene) rings. These compounds are usually categorized as dense, non-aqueous phase liquids (DNAPLs) and will migrate down through the soil and groundwater and pool at aquitards or bedrock surfaces. Solubilities for PAHs decrease rapidly as the number of benzene rings increases. Naphthalene, with two rings, is relatively soluble (34.4 mg/L) and mobile while benzo(a)pyrene, with five rings, is relatively insoluble (0.0038 mg/L). PAHs have high adsorption coefficients and will adsorb onto sediment particles, especially organic matter, so that sediment transport is an important fate process for these compounds. There is some evidence that photo-oxidation can be an important fate mechanism for PAHs. However, the process may be inhibited by adsorption onto organic matter so that in waters with high suspended matter contents (e.g., eutrophic waters), the

relative importance of photo-oxidation as a fate mechanism is dependent on the environmental conditions (USEPA, 1979).

The mobility of chlorobenzene and 1,4-dichlorobenzene is dependent on pH, temperature, atmospheric pressure, and sorbtion characteristics of the soil (USEPA, 1979). These compounds exist in the environment in primarily vapor form, although they are also found in soil and water systems. They are found in clouds, rain, and surface water, and are slightly soluble in water. The solid form of 1,4-dichlorobenzene rapidly sublimes to a vapor. These compounds volatilize from the water column to the atmosphere rapidly (USEPA, 1979). The quantity of the 1,4-dichlorobenzene compound which is available for partitioning from air to water is minor relative to the volatilization of the compound from water to air (USDHHS, 1992). In soil, these compounds are slightly mobile and tend to volatilize to the atmosphere. The presence of organic material in soil facilitates sorbtion, and where there is little or no organic matter available, percolation through soil into groundwater is possible.

PCBs generally have limited mobility in the environment since they have a low vapor pressure and low water solubility. Based on these properties, ongoing PCB transport from the Church & Dwight site to Onondaga Lake is expected to be limited. In the past, however, Church & Dwight did discharge PCBs to the sewer system through the disposal of treated water from the utility tunnel from November 1991 to May 1993. During that time, a total of 1,323,950 gallons (Mailing No. 1, p. 000102) of treated water, limited by permit to 1 ppb of PCBs, were discharged to the sanitary sewer system. It is likely that most of the PCBs discharged to the sewer system were removed at the sewage treatment plant (e.g., by settling [clarification] and adsorption onto the activated sludge beds) prior to discharge of the treated effluent to Onondaga Lake.

In general, ammonia does not last very long in the environment because it is recycled naturally. In soil or water, plants and microorganisms rapidly take up ammonia.

Toxicity

Exposure to 1,4-dichlorobenzene over long periods of time induces liver, skin, and central nervous system disorders. However, when removed from the polluted environment, these disorders gradually disappear. There has been no evidence of developmental, reproductive, or genotoxic effects in humans. There have been studies which indicate developmental, reproductive, or genotoxic effects are possible in animals (USDHHS, 1992). The USEPA Office of Drinking Water lists 1,4-dichlorobenzene as Category B2, or a possible human carcinogen (USEPA, 1979).

PCBs have been shown to cause many toxicological responses including carcinogenic, reproductive, teratogenic, neurologic/developmental, systemic and immunological effects. PCBs are classified B2, probable human carcinogens, based on hepatocellular carcinomas in rodent studies and inadequate yet suggestive evidence of excess risk of liver cancer in humans by ingestion and inhalation or dermal contact (USEPA, 1995). Studies have demonstrated that endpoints as a result of exposure to PCBs have shifted with time, differ among species, and are dependent on dose and exposure duration.

Ammonia does not meet the toxicity criteria under CERCLA, Section 302. However, because of elevated concentrations in groundwater and recognized toxicity, it is considered a potential chemical of concern.

Persistence

In surface waters and near-surface soils, benzene and other VOCs will predominantly volatilize into the atmosphere where they rapidly degrade. In subsurface soils where volatilization does not readily occur, VOCs are much more persistent. Benzene and other VOCs will also leach from soils into groundwater. Once in groundwater, VOCs will not readily volatilize and are relatively persistent.

SVOCs, and particularly the longer-ringed PAHs, are relatively persistent in the environment. The dissolved fraction of SVOCs can undergo rapid photolysis in surface waters. However, the strong adsorption characteristics tend to inhibit photolysis. In

groundwater, SVOCs are persistent. Naphthalene is considered to be the PAH that can biodegrade most easily (USEPA, 1979). For naphthalene in sediments, biodegradation and biotransformation by benthic organisms is the most significant fate process. There is some evidence that photo-oxidation can be an important fate mechanism for naphthalene and other two-ringed PAHs in surface water. Volatilization could be as important as adsorption under certain conditions.

For chlorobenzene, no data have been found indicating that either photolysis, oxidation or hydrolysis are important fate processes in surface waters. Sorption, bioaccumulation, and volatilization are considered competing fate processes. The rate at which these competing processes occur will dictate which fate is predominant in an aquatic environment (USEPA, 1979). 1,4-Dichlorobenzene resists biodegradation due to the additional chlorine atom. Empirical as well as experimental evidence indicates that 1,4-dichlorobenzene is a persistent chemical that is unlikely to be removed during biological sewage treatment, while chlorobenzene is degradable by treatment (USEPA, 1979).

PCBs are persistent in the environment due to their high stability and relative inertness. In aquatic systems, low amounts of PCBs are found dissolved in the water column due to their low solubility and preferential partitioning to suspended matter and sediment. In these systems, PCB transport and persistence is generally governed by the particle transport processes. PCBs have been shown to degrade to a limited extent via dechlorination.

Ammonia occurs naturally in the environment and can commonly be found in large bodies of water at a concentration less than 6 ppm and in the soil at a range of 1 to 5 ppm. As stated above, ammonia does not last very long in the environment because it is recycled naturally.

Bioaccumulation

The potential for bioaccumulation of benzene and other VOCs has been found to be low (USEPA, 1979). Chlorobenzene is expected to bioaccumulate in aquatic organisms as it has

a high affinity for lipophilic materials (USEPA, 1993). USEPA classifies chlorobenzene with an intermediate potential for bioaccumulation (USEPA, 1979). 1,4-Dichlorobenzene is expected to bioaccumulate in aquatic organisms. It has a high affinity for lipophilic materials, and the incorporation of chlorine into an organic molecule increases its lipophilic character (USDHHS, 1992). Therefore, 1,4-dichlorobenzene has a higher bioaccumulation potential than chlorobenzene because it has an additional chlorine atom (USEPA, 1979).

PAHs have shown rapid uptake rates in aquatic organisms from zooplankton to fish. PAHs with two to four rings are readily metabolized and excreted by organisms. The five-ringed PAHs are also readily bioaccumulated in organisms but the rate of metabolism is much slower (USEPA, 1979).

PCBs are very lipophilic and thus tend to bioaccumulate/bioconcentrate within living organisms. Significant levels of PCBs may often be detected in tissue of biota living in contaminated areas and the more PCBs which are absorbed and remain in the organism, the greater the potential for toxic responses.

In soil or water, plants and microorganisms rapidly take up ammonia. The typical pH of spent, un-diluted ammonia is between 11 and 12, which is potentially toxic to marine life (ATSDR, December 1990).

5.2 Quantity of Substances

Based on the available data, the quantity of 1,4-dichlorobenzene and ammonia in the groundwater in the vicinity of the ABC facility and PCBs in the groundwater near the utility tunnel cannot be estimated. The soil beneath Buildings 4 and 7 of the Willis Avenue Plant was most likely contaminated as a result of the presence of two 10,000-gallon fuel tanks which had previously existed at the site. A contractor who was allowed to keep the fuel oil as payment, removed the tanks from the site in the 1960s or 1970s (Mailing No. 1, p. 000066). Church & Dwight did not indicate whether the tanks were intact before removal or were leaking fuel oil. Therefore, it is not possible to determine if the contamination was

the result of a one-time spill of fuel oil, or the result of a long-term historic leak from one or both of the tanks. Consequently, an estimate of the quantity of spilled fuel oil cannot be made.

Quantities of industrial wastes generated on site and disposed at off-site locations are discussed in Section 2.3 and summarized in Table 1. Quantities of wastes discharged to the sanitary sewer and released to the atmosphere are discussed in Section 2.3 and in Chapter 3 of this report. Documented spills are summarized in Section 4.1.

5.3 Levels of Contaminants

A discussion of the extent of on-site contamination, based on the material provided, is included in Section 4.2. Limited analytical data were provided in the Church & Dwight mailings. This includes analytical results of groundwater samples from the ABC site, the Willis Avenue Plant site, and the utility tunnel, as well as soil samples from beneath Buildings 4 and 7 of the Willis Avenue Plant and soil from borings collected along the railroad spur.

Groundwater samples near the ABC buildings contained concentrations of 1,4-dichlorobenzene up to 220 ppb, MTBE up to 200 ppb, benzene up to 36 ppb, naphthalene up to 18 ppb, and ammonia up to 160 ppm. PCB concentrations up to 0.4 ppb were detected in groundwater from the utility tunnel area. A PCB concentration of 2.8 ppb was detected in the water from inside the tunnel itself. At the Willis Avenue Plant site, chloride concentrations ranged up to 13,000 ppm.

Soil beneath Buildings 4 and 7 of the Willis Avenue Plant was found to be contaminated with VOCs and SVOCs. The concentrations of these parameters are discussed in Section 4.2.1. In addition, elevated concentrations of mercury (27 ppm) and other metals were detected in the soil borings installed along the railroad spur adjacent to the Willis Avenue Plant building.

5.4 Impacts on Special Status Areas

The Church & Dwight sites are situated in an area where direct adverse impact to regulated wetlands could have occurred. According to the Syracuse West National Wetlands Inventory map (USDOI, 1978), several federal wetlands exist near the Church & Dwight sites. Approximately 400 feet southwest of the Church & Dwight Willis Avenue Plant is the brine reservoir, which is designated as a POWK2h (Palustrine, Open Water, Artificial, Diked/Impounded) wetland. Approximately 1,700 feet north of the Willis Avenue Plant is a wetland designated L2OWH (Lacustrine, Littoral, Open Water, Permanent), which is the littoral zone of Onondaga Lake. A wetland designated PEM1Cs (Palustrine, Emergent, Persistent, Seasonal, Spoil) is located approximately 2,000 feet east of the Willis Avenue Plant building, along Harbor Brook. A New York State freshwater wetland designated SYW 19 is located approximately 1,500 feet east of the Willis Avenue Plant building, along Harbor Brook. It is possible that contamination from the eastern portion of the Willis Avenue site has impacted the wetlands along the lower reach of Harbor Brook. The eastern edge of the site is approximately 1,000 feet west of Harbor Brook. An investigation of lower Harbor Brook is currently being conducted by Honeywell (BBL, 2001 and O'Brien & Gere, 2002).

Both the East Flume and the reach of Harbor Brook near the site are Class C waterbodies (6 NYCRR Part 895.4). As of August 1996, the New York State "Natural Heritage Sensitive Element" nearest to the Church & Dwight facility was located approximately 1.4 miles northeast of the site, on the opposite side of the lake. It is not likely that this area has been affected by contamination from the Church & Dwight sites.

6.0 SUMMARY OF CONCERNS

Based on the data and information provided by Church & Dwight, the following concerns are identified:

- Groundwater samples near the ABC facility contained concentrations of 1,4-dichlorobenzene up to 220 ppb, MTBE up to 200 ppb, benzene up to 36 ppb, naphthalene up to 18 ppb, and ammonia up to 160 ppm. O'Brien & Gere concluded that the ABC facility is the likely source of elevated levels of ammonia, chloride, and dichlorobenzene in the groundwater (Mailing No. 1, p. 002610). However, methyl tertiary butyl ether (MTBE) was also detected in the groundwater, causing O'Brien & Gere to suggest that the source of the dichlorobenzene may be a gasoline storage tank upgradient of the ABC site (Mailing No. 1, p. 002607). An investigation of a nearby source of chlorinated benzenes is being performed by Honeywell (O'Brien & Gere, 1999). O'Brien & Gere suggested that an inventory of all chemicals used at the sites be prepared, and testing for additional inorganic parameters, e.g., heavy metals, would be necessary (Mailing No.1, p. 002611). However, Church & Dwight did not provide any documentation of any follow-up action on these recommendations.

- Groundwater in the vicinity of the Willis Avenue Plant contained elevated levels of total dissolved solids, chloride, alkalinity, and phosphorus. The contaminants found in samples from the Willis Avenue Plant site are believed to be the result of overflow from the brine reservoir located just south of the plant (Mailing No. 1, p. 002611).

- PCB concentrations up to 0.4 ppb were found in groundwater from the utility tunnel area adjacent to the Willis Avenue Plant. A PCB concentration of 2.8 ppb was detected in the water from inside the tunnel. Although the utility tunnel was sealed and utilities were relocated to prevent further seepage of PCB-contaminated groundwater into the tunnel, no action appears to have been taken to identify and remove the source of the PCBs. Church & Dwight believes that the PCBs are the

result of activities by Allied prior to Church & Dwight assuming ownership of the various former Allied properties (Mailing No. 1, p.000097).

- In the "Ground Water Assessment" report prepared for Church & Dwight in 1988, O'Brien & Gere indicated that between 5 and 15 feet of fill material in the vicinity of the ABC facility consists of "layers of gravel, sand and cinders and a grayish white powdery ammonia bicarbonate sludge" (Mailing No. 1, p. 002603). Soil samples from this area were not included in the documents available for review. It was also indicated that there is "up to 21 feet of fill composed of a mixture of sand, gravel, cinders, and miscellaneous construction debris (concrete, bricks, etc)" downgradient of the Willis Avenue Plant (Mailing No. 1, p. 002604). Elevated levels of mercury and other metals were detected in samples collected from borings that were installed along the railroad spur located adjacent to the Willis Avenue Plant. The source and extent of this contamination were not discussed in the mailings.

- The majority of stormwater from the ABC and Willis Avenue Plant sites flows to the Allied storm sewer system, which has discharged into the East Flume of Onondaga Lake. There was at least one recorded incident of an unplanned discharge of sanitary and industrial wastes containing ammonium bicarbonate and aqueous ammonia to the stormwater collection system that Church & Dwight shared with Allied. It was determined that a partial blockage in the sanitary discharge line caused overflow into the storm sewer system. Several NOVs were issued, including one in May 1994 in which OCDDS issued a Compliance Order to Church & Dwight to study and develop a plan to reduce nitrogen (TKN) in wastewater from the ABC facility. The order required Church & Dwight to develop a plan for source reduction opportunities for ammonia at the ABC facility (Mailing No. 1, pp. 003658-003662). Some reduction in ammonia was achieved as a result, prior to closure of the ABC plant in 1996. However, the source control methods were not discussed in the mailings. USEPA Form R submittals indicate that annual average of 395,732 lbs of ammonia were

discharged to the municipal sewer system from 1987 through 1996, which could have caused adverse effects to the Onondaga Lake system.

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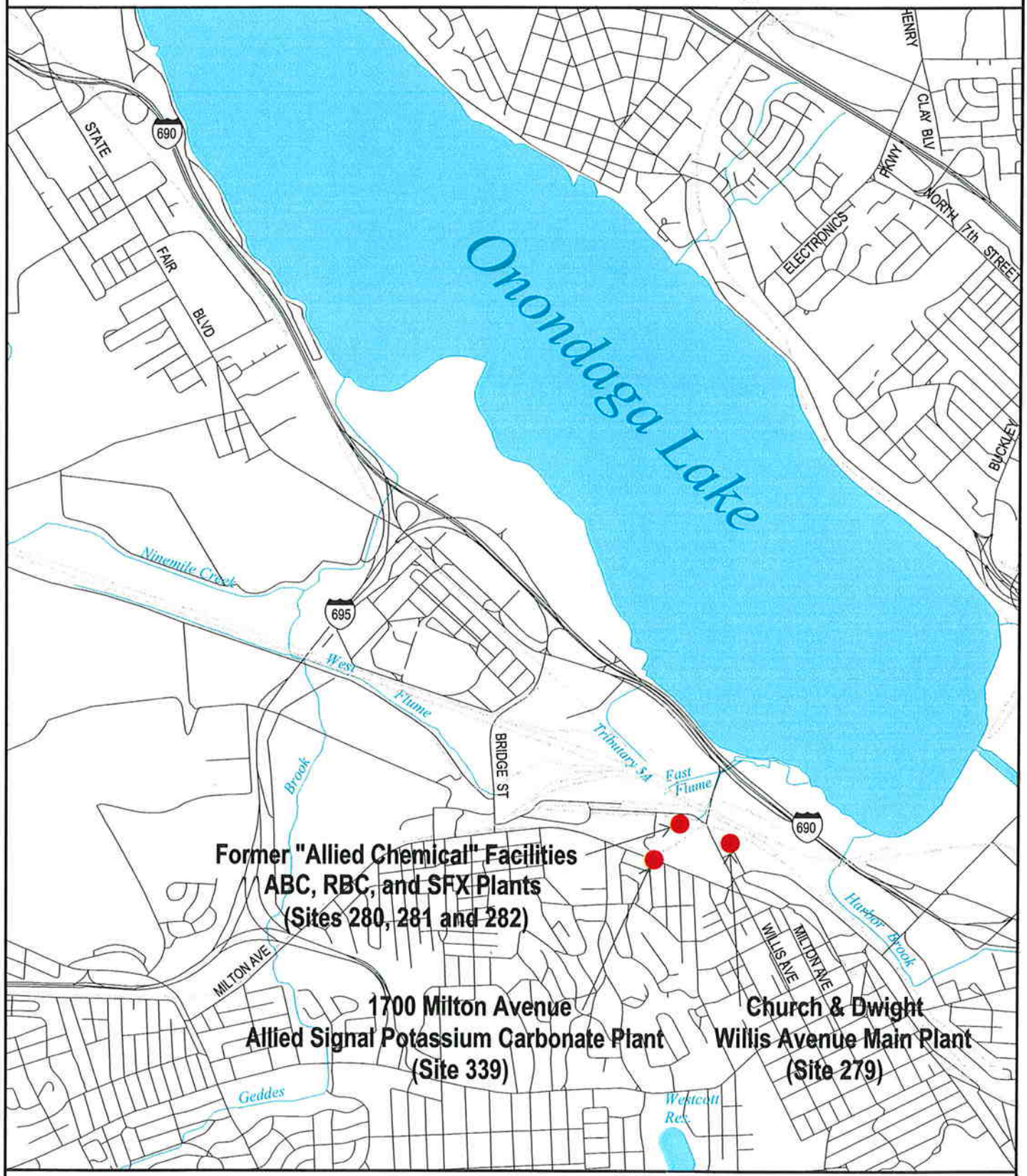
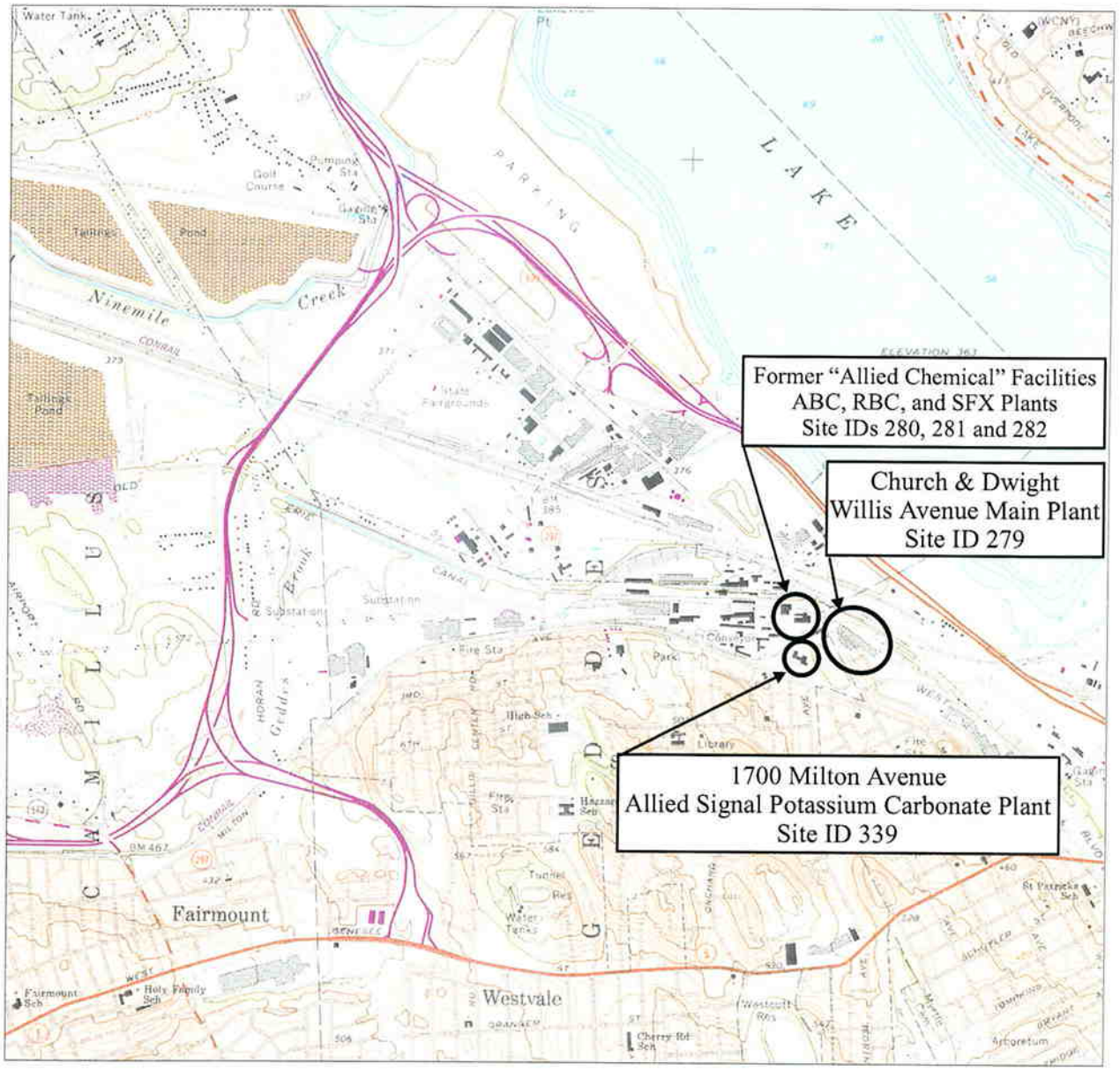


Figure 1



SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETRE

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS 363 FEET IN ONONDAGA LAKE

United States Geological Survey
Syracuse West Quadrangle
Onondaga County, New York

N

TAMS

Figure 2
Church & Dwight
Site IDs 279, 280, 281, 282, and 339

CHURCH & DWIGHT
SITE PLAN

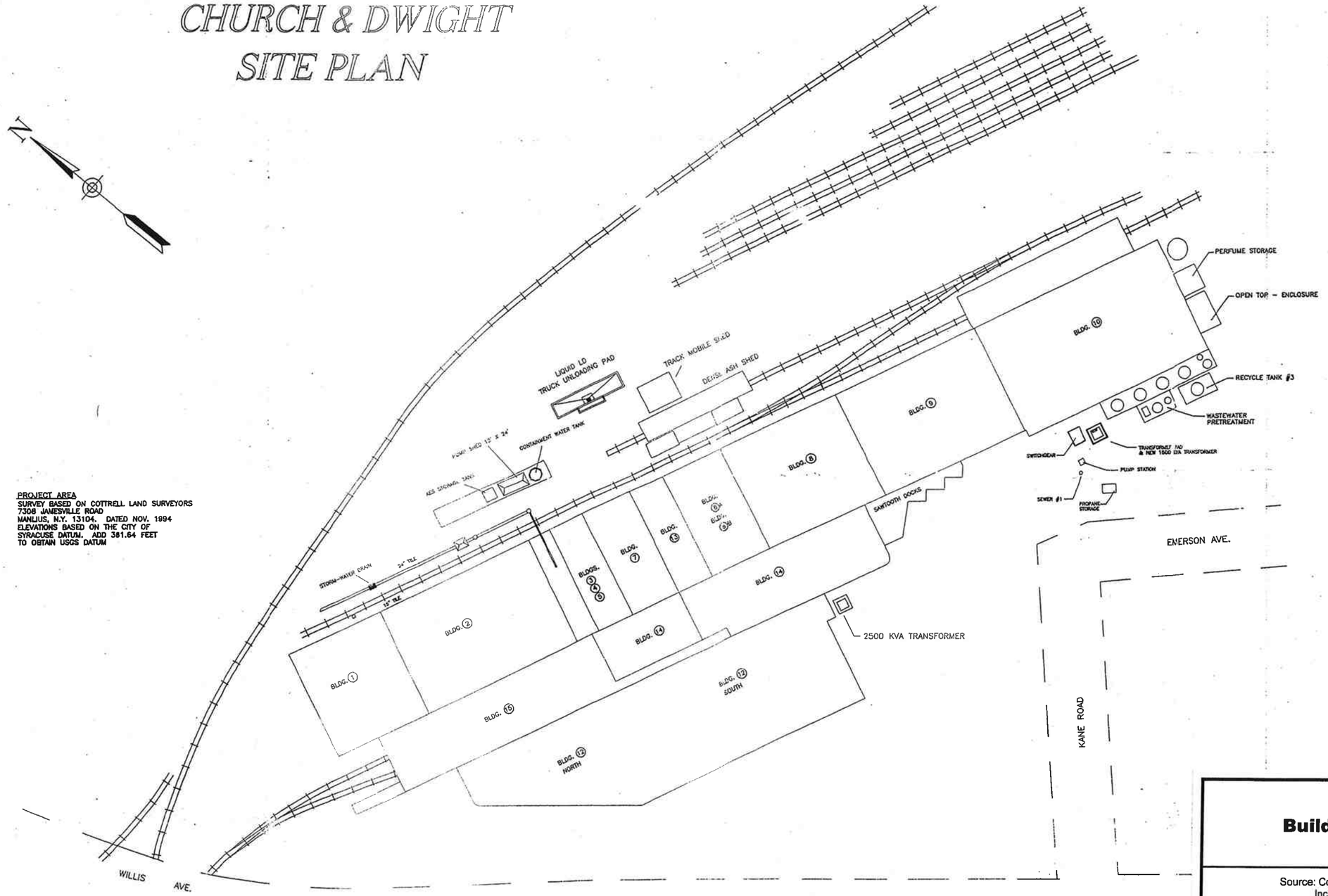


FIGURE 3
Building Location Plan
Main Plant

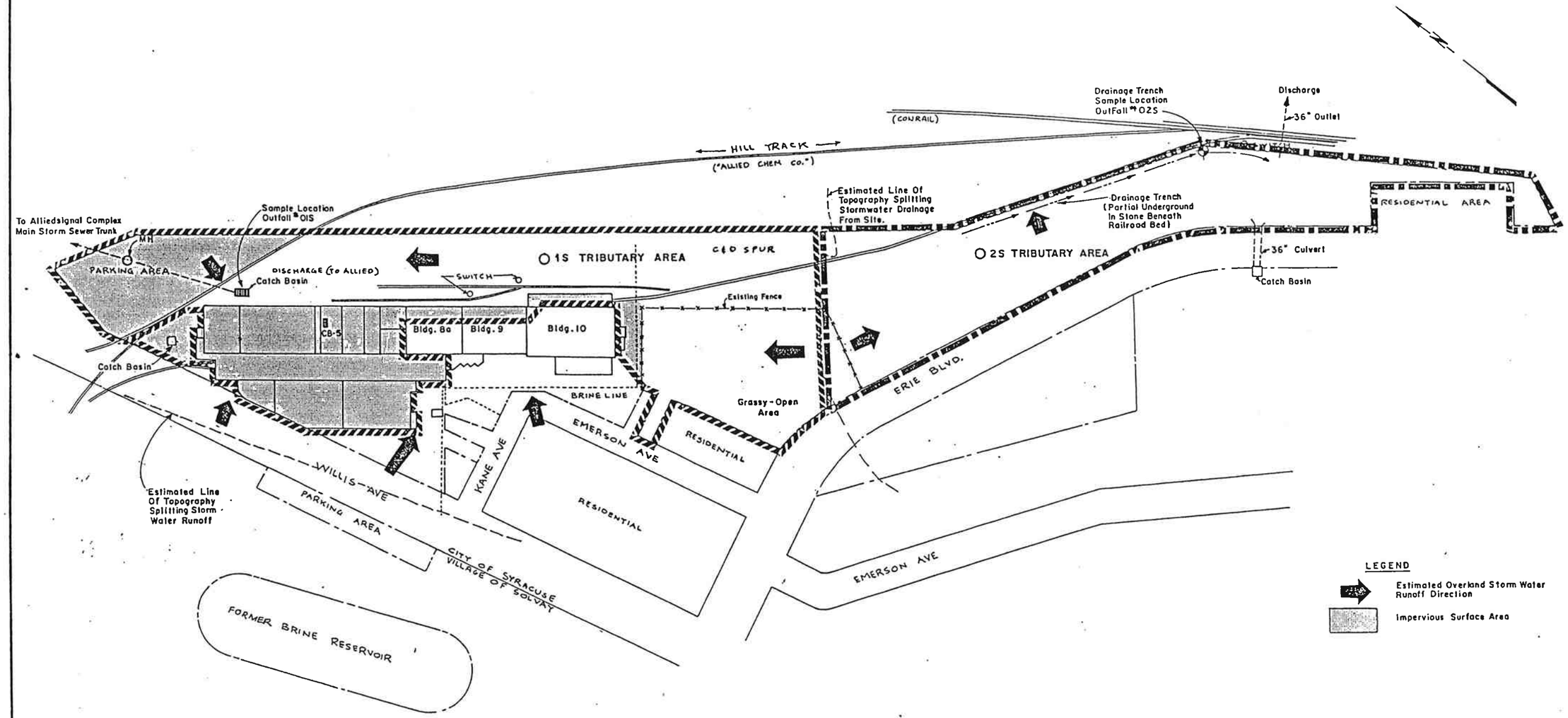
Source: Cottrell Land Surveyors. (October, 1996)
Included in Mailing #1, pg 003481

REVISIONS

NO #	DATE	BY	SUBJECT
1	10/9/96	CJS	LIQUID MODIFICATIONS

DRAWN BY: Craig Soller	DATE: 10-9-96	APPROVED BY:	
CHECKED BY:	DATE:		
SCALE: NO SCALE	PROJECT NO.:	DWG. NO.: PU11282-A	

CD003481



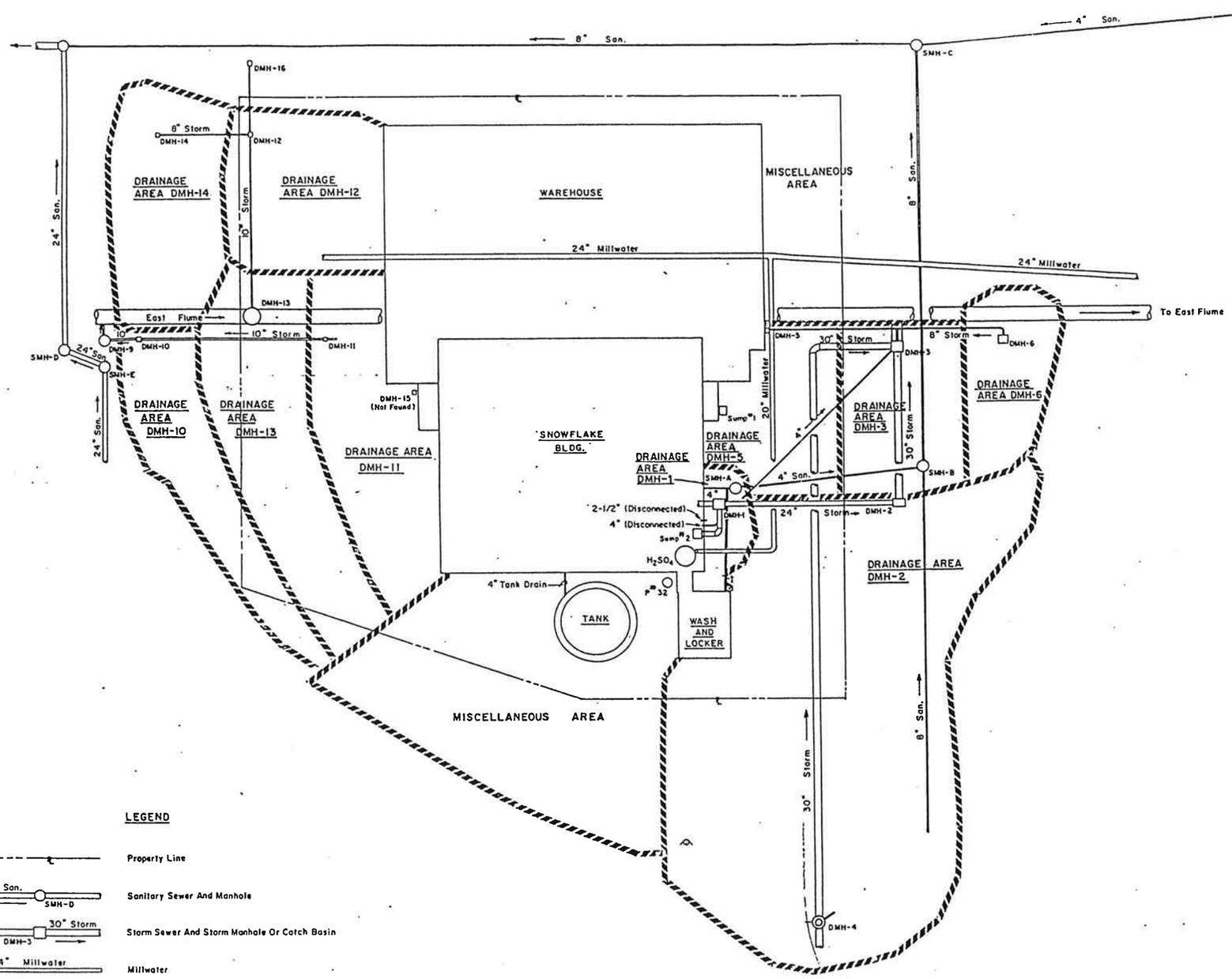
PLAN
Scale: 1" = 100'

CD003836

FIGURE 4
Drainage Plan
Main Plant

Source: C&S Engineers (April, 1993)
Included in Mailing #1, pg 003836

IN CHARGE OF
MADE BY
CHECKED BY



LEGEND

- Property Line
- 8" San. / SMH-D — Sanitary Sewer And Manhole
- 30" Storm / DMH-3 — Storm Sewer And Storm Manhole Or Catch Basin
- 24" Millwater — Millwater
- Drainage Area Boundaries

PLAN
Scale: 1" = 20'

1"=20' 20 0 20 40 FT

NO ALTERATION PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

IN CHARGE OF:
DRAWN BY: F.E.Bristol
CHECKED BY:

NOTES:

1. West Influent To DMH-1 Is Fully Plugged. South Influent Is One-Half Plugged.
2. Sump No.2 Was Plugged And Abandoned In Place On March 23,1992

NOTE

This Drawing Taken From O' Brien & Gere Engineers Inc. Outside Piping Plan , Dated April 1992 And Allied Cemical Corporation Storm And Process Sewer System, Revised 1975.

CD003838

FIGURE 5
Drainage Plan
ABC and Snowflake Facilities

Source: C&S Engineers (April, 1993)
Included in Mailing #1, pg 003838

4" Leach Line Beneath Stone Along Railroad Bed Empties Into Flex Flex Hose Leading To CB-1

CB-1

MH

Old loading Dock

CB-3 (Plate Cover)

CB-2 (Plate Cover)

CB-4 (Filled In)

Trackmobile Garage

Soda-Ash Transfer From Railroad Cars (Soda-Ash On Ground In This Area)

Secondary Containment Drainage Pipe

Fuel Storage. 550 Gallon No. 2 Diesel Fuel

Aboveground Tank With Secondary Containment

Railroad Tanker Car Transferring Ethoxylated Alcohol By Hose Into Building

Scrap Metal Dumpster

Paved Area

CB-5

Truck Loading Area

Rail Car Unloading Dock

CHURCH & DWIGHT

SEE FIGURE NO.4

WILLIS AVE.

Landscaped And Stone Covered Area

Truck Loading Area

Paved

Automobile Parking

Truck Loading Docks

Truck Loading Area

Paved

Automobile Parking

KANE ROAD

Sulfuric Acid Truck Unloading Area

Sulfuric Acid

Waste Water Treatment Storage Tank With Secondary Containment

Paved

Sulfuric Acid

Ethoxylated Alcohol

4" Drain Pipe

Sulfuric Acid Incidental Spill Collection

Small Building Addition

Storage Of Metal Bins, Scrap Metal Scrap Wood

SEE FIGURE

- #6 FUEL UNDERGROUND OIL TANK LEAKAGE/SOIL REMOVAL
- SPILL OF RAW MATERIAL FOR LIQUID LAUNDRY DETERGENT
- FUEL OIL RESIDUAL UNDER BUILDING #4
- RELEASE OF POWDERED LAUNDRY DETERGENT
- NON REPORTABLE ETHOXYLATED ALCOHOL SPILL
- SODA ASH - RAILCAR UNLOADING
- NON-REPORTABLE MERCURY SPILL IN BUILDING #10
- NONREPORTABLE SULFURIC ACID SPILL (195)
- 1989 REPORTED SULFURIC ACID RELEASE
- 1990 REPORTED SPILL OF POLYACRYLIC ACID

PLAN
SCALE: 1" = 60'

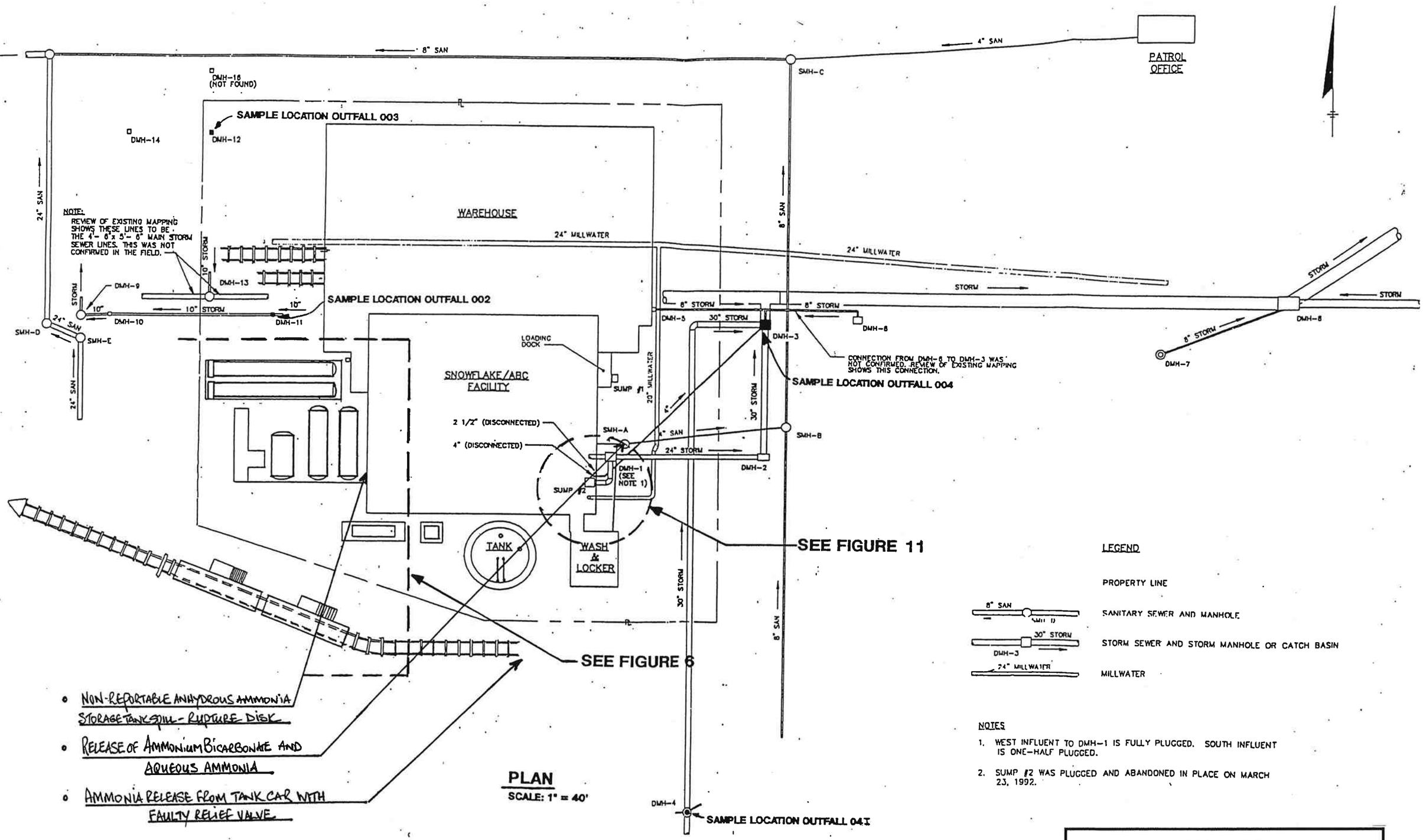
SuppCD000231

IN CHARGE OF:
MADE BY:
CHECKED BY:

NO ALTERATION PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION

FIGURE 6
Historic Spill Locations, Main Plant

Map originally prepared by C&S Engineers (April, 1995)
Modified by Church & Dwight and included in Mailing #8, pg SuppCD000231



PLAN
SCALE: 1" = 40'

LEGEND

- PROPERTY LINE
- 8" SAN / SMH-D — SANITARY SEWER AND MANHOLE
- 30" STORM / DMH-3 — STORM SEWER AND STORM MANHOLE OR CATCH BASIN
- 24" MILLWATER — MILLWATER

NOTES

1. WEST INFLUENT TO DMH-1 IS FULLY PLUGGED. SOUTH INFLUENT IS ONE-HALF PLUGGED.
2. SUMP #2 WAS PLUGGED AND ABANDONED IN PLACE ON MARCH 23, 1992.

SuppCD000232

THIS DRAWING MADE FROM OBRIEN & GERE DRAWING 1, FILE NO. 2488.326- , DATED APRIL 1992

FIGURE 7
Historic Spill Locations, ABC and Snowflake Facilities

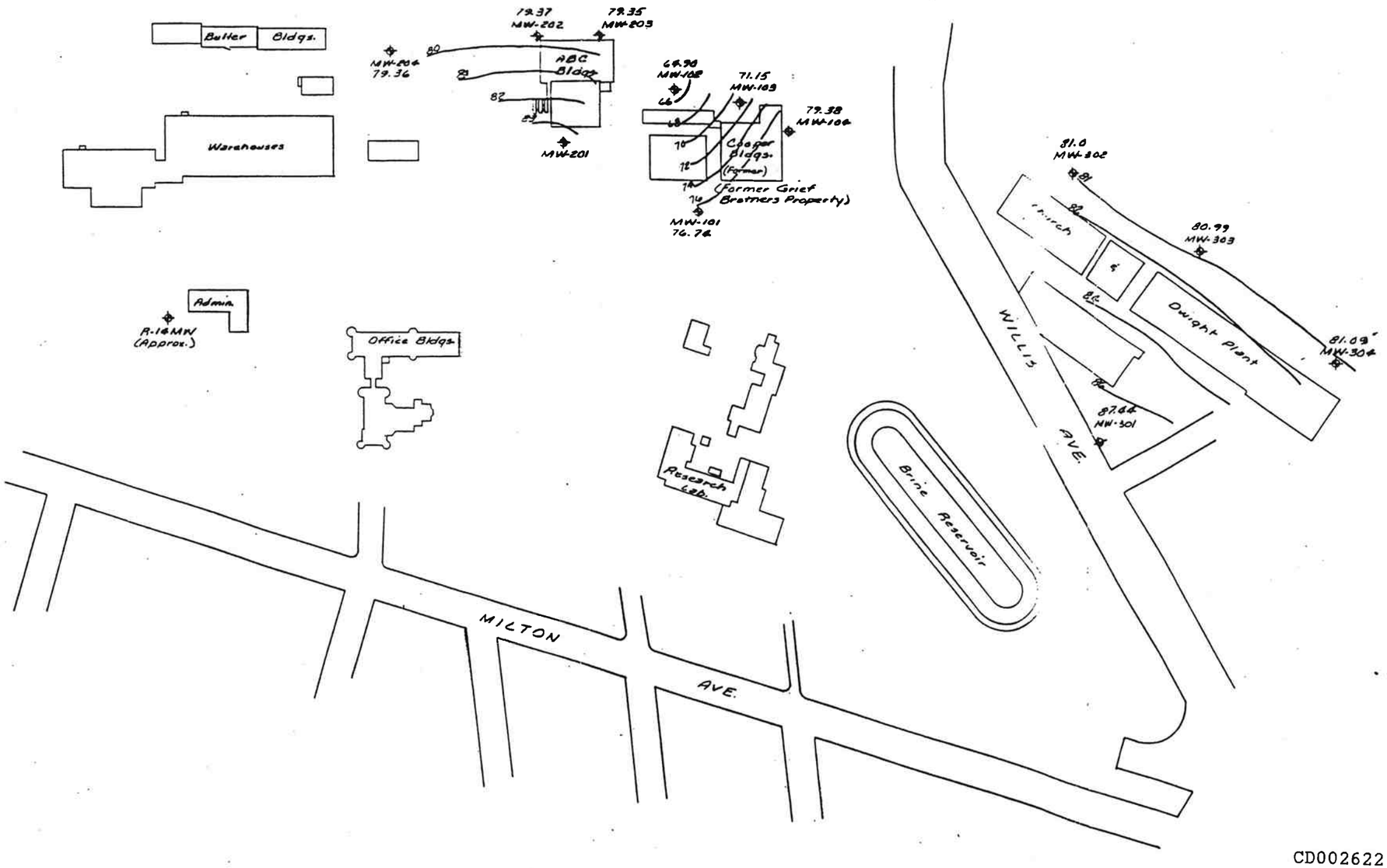
Map originally prepared by C&S Engineers (April, 1995)
Modified by Church & Dwight and included in Mailing #8, pg SuppCD000232

FIGURE 8
Monitoring Well Locations and PCB Concentrations

Map originally prepared by O'Brien and Gere Engineers, Inc. (July, 1992)
Included in Mailing #1, pg 002463

FIGURE 9
Groundwater Contour Map

Source: O'Brien and Gere Engineers, Inc. (January, 1988)
Included in Mailing #1, pg 002622



CD002622

In charge of ____ Designed by ____ Checked by ____ Made by MAB		NO.	DATE	REVISION	INIT	O'BRIEN & GERE ENGINEERS, INC. Syracuse New York

CHURCH & DWIGHT
SITE PLAN
GROUND WATER CONTOUR MAP 1-11-88

FILE NO. 2466.157.
DATE JAN. 1988